Waterfowl on a Pacific Estuary

A Natural History of Man and Waterfowl on the Lower Fraser River

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1982

For Rex and Bernard, John and Walter,
past companions in the marshes and fields
of the Thames and the Weser.

FOREWORD

The Fraser River has shaped both the history and prehistory of British Columbia. It is *the* river of the province. Half of all British Columbians live today in or by the Fraser's valley.

Older than the mountains it drains, the mighty Fraser has carried cubic miles of pulverized mountains down its long and boisterous course for millions of years. As the endless flow of water slowed on approaching and entering the sea, the rocky debris settled out, grain by grain through years too numerous to comprehend. This built the Fraser Delta, the flatlands on the valley floor between Hope and the sea.

The Fraser is the main artery of British Columbia; its delta is the heart of the political province. In this heartland lie both the city of Vancouver, third largest in Canada with its harbour the nation's portal to the Pacific world, and the contrasting, placid cattle that idle in the miles of green fields comprising the only extensive agriculture on this mainland coast of western Canada.

These flats, rich and well-watered, once held abundant wildlife. The story unfolded in this book is a history of that natural history, a chronicle of those wild lives that once lived in a very fertile place, and of how the land—and so its wildlife—has been changed by over a hundred years of impact with European man.

This history of nature is the theme that attracted us to this book, for the *natural* history of important and well-known places is nearly always lost. Everyone sees it and knows it in his own time, but so often the dying of a generation is the vanishing of what was known. Our cultural memory is fragile and easily lost, especially the memories containing those lives in the landscape other than human lives. Most people are most interested in people, but those interested in forests and marshes, in geese and trout are fewer. The historic record rarely contains what most dismiss as only scenery and mere wild animals that will always be there—or so it is believed.

So the story here is an unusual history with a biological bias of an unusual part of British Columbia. The author's desire to preserve and enhance parts of the Delta for wildlife conservation is an appropriate accompanying theme, not strictly speaking "museum" but logical "historic site" and "nature preserve". The three are parts of a whole, the historic record composed of historic things, historic places, and the natural pre-historic base that has somehow survived.

The next time you are in the Fraser Valley, anywhere between Rosedale and the sea, remember that not many decades ago the valley floor looked nothing like it does today. Much has been changed and, in the process, British Columbians have both lost and gained. Gains are

usually evident; losses rarely are. This book ensures that at least some memory of how it was will not be lost, and suggests, as well, that some surviving fragments of how it was, need not be lost.

It is a dead delta that does not have the music made by wild geese.

YORKE EDWARDS
Director

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I am greatly indebted to many people who have contributed to this study. It began when Mrs. Florence Robertson of Westham Island, Edgar Fenton of Ladner and Harry Weaver of Mud Bay related to me some of their memories of the early days on the marshes of the lower Fraser. Ron Tarves of Cloverdale, Bill Hastings of White Rock, and Miller Lougheed of Crescent Beach fostered my interest in local history and put me in touch with many knowledgeable contacts in the Lower Mainland. These included Mrs. Sahra Wells and Mrs. Marie Weeden, widow and daughter of the late Oliver Wells, who generously gave me full access to his records and papers, including his correspondence with Allan Brooks. Another invaluable loan of notes and press cuttings came from Mrs. Aldah Holdom, widow of Canon Martin Holdom of Crescent Beach. The Canon's natural history columns *Wanderings with Dom*, together with the notes of Bob Lusher of the Vancouver Natural History Society, provided valuable insights into the changes in the bird life of the Lower Mainland coast over four decades. To these sources were added the early records of the natural history of British Columbia made available to me by Rob Watt at Vancouver's Centennial Museum, Anne Yandle at the Special Collections Division of the Library, University of British Columbia, Ann Datta at the Zoological Library of the British Museum, London, and Wayne Campbell at the British Columbia Provincial Museum, Victoria. Professors Vernon C. Brink and Margaret North of the University of British Columbia gave me useful advice on the changing plant life of the Lower Mainland; Alan McMillan of Douglas College and Keith Hodgson added recent data to the chapter on the Indian people of the river and coast; and Robert C. Harris of West Vancouver gave me the benefit of his detailed knowledge of the early maps and explorations on the west coast. I also owe thanks to George Woodcock, Eva Bene, George Wootton and Ian McTaggart Cowan who, from different points of view, all encouraged my studies in the natural history of the Lower Fraser.

In recent years the contributions of naturalists have become an increasingly important part of our knowledge of the lower Fraser and Al and Jude Grass of the Vancouver Natural History Society, Madelon Schouten and Jack and Rosamund Sarles of the White Rock and Surrey Naturalists, and Wilma Robinson of the Alouette Field Naturalists are but a few of the many whose observations have contributed to this study. In the field of conservation I am indebted to the staff of the Canadian Wildlife Service and the British Columbia Fish and Wildlife Branch for insight into the challenges and problems of wildlife management on a crowded delta and estuary, especially to Ernie Taylor whose service in both federal and provincial departments gave him a broad overview, to Slim Cameron and Art Butler whose years of experience as conservation officers in Delta and Chilliwack covered

periods of significant change, and to Bill Munro whose proposed management plans have now renewed hope for several species of waterfowl that have suffered heavily from human pressures since white settlement. The recent shift from law enforcement and record keeping to more practical measures to protect and improve habitat have been due in no small degree to the work of non-government agencies. Foremost among these, both in terms of time and scale, is Ducks Unlimited (Canada), an organization that has pioneered the restoration of wetlands across the country. I am indebted to Tom Sterling, Gunnar Campbell and Fred Bard who helped me to get to know the methods of this great band of dedicated field workers, backed by an efficient fund-raising structure in the United States. I have also learned much from Richard Trethewey, a director of Ducks Unlimited (Canada), who is also president of the Pitt Waterfowl Management Association and a moving spirit behind the restoration of waterfowl and Sandhill Cranes in the Lower Mainland.

I owe thanks to the many writers and publishers who gave permission to quote their works and to Dr. Geoffrey Mathews of the Wildfowl Trust for allowing me to include as Chapter 16 the article *A Slimbridge in British Columbia*, first published in *Wildfowl* in 1970.

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The Delta

When we first came and saw this land
Many said "This is a grey land,
The sky hangs heavy upon it,
And dullness, like a spread cloak,
Weighs down the air
Upon the brown earth."

Yet this is a land of toil and hope,
The soil is heavy to the plough,
Burdened with water, but fruitful.
Those who dwell here look to the sky,
For the sky has promise and colour;
It tells of the day and of the morrow.

The idle contentment of summer is not here,
But racing clouds, storms' challenges;
More than the glaring void of the South.
Here the sky is not empty, nor is it silent.
It is filled with the changing of the elements
And with the cry of sea birds.

The earth receives from this sky
And is richer.

B.L.

INTRODUCTION

The uses made of the river and its associated lands are of tremendous value to the people of the Lower Mainland, but the river is something more than the foundation of economic activity . . . To the man fishing from a bar, to the person watching waterfowl in the marshes, to the child paddling in a pool, the river adds a richness to life that is difficult to measure. It is a link that people have with the complex ecological system of which they are a part. And along with the mountains and the sea it is the essence of this region of British Columbia and it is part of what people mean when they call it home.

Irving Fox, 1976

Much of the appeal of waterfowl lies in their setting. Wide marshes, open shores and ever-changing skies form the natural backgrounds for these constant travellers. Their enormous journeys also contribute to their romance. They are at once a signal of the seasons and a symbol of a relentless determination to survive. Their movements are dictated by the need for habitats that provide food and security for resting and for breeding. But today man dominates much of their habitat in the river valleys and deltas of the world and the survival of waterfowl lies to a great extent in his hands. Fortunately, in Europe and North America, the recreational value of waterfowl was recognized just in time to save them from destruction. When this happened, in the first half of the twentieth century, there was still enough of the Fraser Delta left in a natural state for it to be the best wintering place for waterfowl in Canada.

Since then, surprisingly little has been done to foster wide public appreciation for the marshes of the lower Fraser Valley or for their bird life. Several societies and associations have taken the initiative in establishing sanctuaries and nature parks, but government agencies have not yet developed imaginative management policies commensurate with the wonderful potential for recreation areas and ecological reserves on the publicly-owned lands along the foreshores or in the marshes of the Lower Mainland. Access to the shores of the estuary and the delta is limited and to the majority of people the marshes of the lower Fraser River are unknown. Of those who are familiar with the delta and its wildlife today, few are aware of the riches that have been lost. The continued passage of migratory birds across the delta each year has concealed the decline and disappearance of several species and prevented timely action to relieve the pressure of human disturbance upon their daily life-cycles.

If the waterfowl of the Fraser Delta are to survive in the future their needs must be judged in the light of their past history. For various reasons this history has been ignored or overlooked. It is still not too late to repair this omission. For this reason I regard this book a "natural history," using these words literally, because I believe the history of the past to be a useful guide for the future management of waterfowl. It provides a picture of the natural traditions that have governed the movements and ranges of the waterfowl native to this valley since the last Ice Age, and traces some of the changes brought about by man's settlement.

Since the pioneers have a firm place as the heroes of our human history, some readers may see implied criticism in my description of their impact upon the natural life of the lower Fraser. This is not my intention. To criticize, from the economic security of the twentieth century, those early settlers who ruthlessly shot and trapped the abundant wildlife around them, would be unreasonable. However, a dispassionate examination of their history should not underestimate their impact out of concern for the sensibilities of those who today shoot and trap for pleasure. Nor should nostalgia for the past and for the freedoms of the frontier blind us to the realities of the present.

Other readers may see this book as an attack on hunting, but I hope that the more perceptive will recognize it as an attempt to urge that element of restraint that is the first essential of true conservation—putting the needs of wildlife first. If this is done, all, including the hunter, will benefit.

There is no doubt that hunters and naturalists have played a major role in the preservation of the Fraser marshes. But this cannot entitle them to the exclusive use of lands and resources that are the property of all the people. To expect this would be to endanger what has been achieved in the past, for the lower Fraser will not be saved from further

destruction solely by the economic value of wildlife recreation, nor even by the biological significance of wetlands. It will be saved by its emotional value to the people of Greater Vancouver, and by its aesthetic appeal to their sense of place.

My research into the history of the Lower Mainland and my observations of events in the last two decades have led me to the conclusion that the deficiency of management of waterfowl in this area is the result of four factors:

- — Disregard of the natural history of waterfowl showing their decline on the lower Fraser in the nineteenth century;
- — a failure to take full account of the effect of disturbance caused by hunting upon the daily cycles of the surviving waterfowl population;
- — a lack of experience, expertise, or demonstrable interest in management agencies for non-hunting recreation associated with waterfowl;
- — a lack of funds due in part to the failure of management agencies to capture the interest or support of a wider public.

In the hope of focussing attention upon these factors, I have written this book, and am encouraged that shortly before its completion a former head of the Canadian Wildlife Service, W. Winston Mair, a man with a life-time of experience and expertise in the field of wildlife management, called for "a quite positive policy . . . an imaginative set of objectives directed to enhancement and recovery of fish and wildlife resources" in the Lower Mainland.

The adoption of such a policy could not only ensure the enhancement of present waterfowl populations in the lower Fraser marshes, it could also lead to the recovery of some populations lost or depleted by the impact of white settlement in the nineteenth century. I have no delusions about "putting the clock back" and trying to revive the environment of the Fraser Valley destroyed by the changes of the last 150 years. However, I do feel that we should now pause and take stock of what we have left and consider how we should use the lands and resources which still remain in a fairly natural state. If we are indeed to achieve a "livable region" in Greater Vancouver, some of these areas will serve us better if left undeveloped as open space, recreation areas or conservancies. In my view, such areas are of a greater value if the natural systems within them continue to function. Empty marshes are bleak and dull, but fill them with the flight of swans, with the voices of wild geese or with the thronging hosts of ducks descending from migratory flights out of the northern tundra and they awaken, even in our urbanized Canadians, a spark of understanding for the lands and waters and their living creatures which are part of our heritage.

PART ONE: HABITS AND HABITAT

Time must be devoted to the investigation of . . . living things, however simple or elaborate they may be, and their place in nature, and their interdependence, and the rules and laws that govern these things and to the study of the lattice of life and the place of man in it; and to mixing history, geography, geology, meteorology and biology together to make the most inspiring of all disciplines: scientific natural history.

James Fisher, 1970

1. The Hunter's Paradise

(For) the third generation . . . on the old farm . . . the days of the hunter's paradise were at their best. To the West, Sumas Lake, 10,000 acres of water and 20,000 acres of marginal lands and sloughs, was the resting place and feeding ground of millions of ducks and geese. To the East was the big Indian Prairie, thousands of acres of swampy marshy land, feeding grounds for countless swarms of migrating waterfowl . . . for hours at a time great flocks filled the sky as they winged back and forth from one feeding ground to another. For weeks the valley was full of migrating waterfowl.

Oliver Wells, 1967

Today the delta of the Fraser River is dominated by the city of Vancouver. The waterfront is filled with docks, wharves, mills and warehouses. The river is busy with boat traffic and the delta's islands are linked by rail and road bridges and a tunnel. Highrise buildings now stand where only a few decades ago huge firs and cedars covered the land. Farms have taken the flood plain from the river and drained the delta's marshes to provide dairy products, beef and vegetables for the city's population.

Yet there are places on the lower Fraser where the wild landscapes of the marsh and shore can still be seen, where ducks and shorebirds still come on the winds of autumn and where Snow Geese still fill the dawn and dusk with the clamour of their voices. Such places remind us of the formidable task that confronted the pioneer settlers who began the process of subduing the wilderness on the Fraser. Most of their

tools were simple and cheap: the steel trap, barbed wire, the flood-box, the axe, and the two-handed saw. A few machines like the riverboat, the steam scow and the railway were complex marvels of the Industrial Revolution that eased the burden of toil and sped the process of change. But the one that occupies the most lasting place in the mythology of the West is the gun.

In the second half of the nineteenth century, improvements in the rate of fire and accuracy of small arms had a profound effect upon hunting. The reduction of the American bison and the extinction of the Passenger Pigeon were only the best known results of the period of unrestrained shooting, which lasted well into the twentieth century and depleted the shorebird populations of the Atlantic seaboard (Mattheissen and Stout, 1967).

In the West, the pioneers relied heavily upon wild game to provide meat, especially during the initial period of settlement. Their guns were kept ready to hand as a matter of course. To those on the lower Fraser, the marshes of the delta and the floodplain seemed like a hunter's paradise. Oliver Wells described, in the history of his family's farm at Sardis, near Sumas Lake, how:

> Great flocks of Canada Geese and occasionally large flocks of White-fronts would settle into a grain stubble field. Edwin (Wells), or one of the men, would use a horse and cart for camouflage and walk up close enough to make a kill, never for sport, but for food. In the fall, from the rafters of the wood-shed would hang rows of mallard ducks and Canada Geese (Wells, 1967)

Bag limits, seasons and other restrictions were unknown. The hunter's purpose was to shoot as many birds as possible. Pioneers recalled that 15 or 20 Mallards were brought down with one shot. Bags of ducks often exceeded what could be used, and ". . . killing too often was for killing's sake only." (Matsqui-Sumas-Abbotsford Centennial Society, 1958). Later, as society became more urbanized, trappers and fishermen met the growing demand for game by seasonal market hunting. The pressure upon the wintering flocks of waterfowl was continuous and unrelenting, especially in the meadowlands of the natural prairies which were both the traditional feeding places of many ducks and geese and the sites of the first agricultural communities.

Edgar Fenton recalled the days of market hunting in the 1890s at Ladner's Landing, then a growing centre of the salmon canning industry and the place from which much of the agricultural produce of the delta was shipped up river to New Westminster or across the strait to Victoria (Fenton, 1974). In his "old white store," Harry Hutchinson would trade powder, shot and groceries for ducks and geese. A successful shoot often provided the means for a cheerful Christmas as it did one year for Joe Jordan, who took his gun down to Beach Grove where, on the lagoon behind the sand spit, he saw a great flock of

ducks. So he crawled behind the new dyke till he was in range, poked his gun over and fired both barrels. As the smoke cleared, he saw over forty birds lying on the sand and he had to borrow a packhorse to bring them into town. Encouraged by the large bags, several Ladner men like Davie Leary, True Oliver and the Parmiter brothers became market hunters and shipped fowl by the sack to dealers in Victoria and New Westminster.

Further east, Sam and Harry Weaver also took up market hunting. Born in England in 1881, Harry came to Canada as a young boy and worked with his father and his uncle on their farms on the shores of Mud Bay and Boundary Bay. He began hunting with a muzzle-loader in 1895 when he was fourteen, and shot Brant and ducks out on the mud flats from a punt or a blind using 40 decoys carved from solid blocks of maple. He also lay in wait for Canada Geese in the wide fields north of the Boundary Bay or shot them when they flew from the open sands to eat berries in Burns Bog. At 94 he retained clear memories of the days when he and his brother, Sam, regularly filled 100-pound bran sacks with 60 ducks each and delivered several dozen birds twice a week to George Adam's store in New Westminster. In one year, Harry shot 1,800 ducks. A brace of Mallards fetched 40 cents, Pintails 35 cents and a quarter for a teal. Brant and Canada Geese were regularly sold, the latter for 75 cents (Weaver, 1975).

The market hunters did not have the field to themselves. "When you walked down a Ladner street at night," recalled Edgar Fenton, "all you could hear was the pounding of folks loading shotgun shells. The whole town seemed trigger crazy. The kids started with sling shots and graduated to old muzzle-loaders. But there weren't many accidents in the old days. Every house had a gun or two and folks knew how to handle 'em then."

Most of the shooting was done with double Damascas-barrelled shoulder guns. At first some market hunters preferred 10-gauge or even 8-gauge "goose guns", but the 12-gauge was soon recognized as the best all-round gun for everything from snipe to geese. Most of the duck hunters shot from yellow cedar punts, but none, as far as I know, ever used the great 1½"-bore punt guns popular with English fowlers at that time.

Accounts of duck shooting in British Columbia in the nineteenth century are rare, but one by an English sportsman writing under the pseudonym, "Kirly Hare", was published with the title, "British Columbian Wildfowl," in *Fore's Sporting Notes*, Volume 13, dated 1897. The writer described a visit to the lower Fraser 30 years earlier. He hired a canoe from an Indian near New Westminster and, after paddling for a whole day, reached a log hut on the shore of Mud Bay owned by his guide, Augustus Longhurst. This character, known as Gassy Long, was a market hunter with the reputation of being the "most accom-

plished liar" and "the worst shot in the colony." His method of hunting was "to hide in some snug retreat close to a good feeding-ground, and rake down the wildfowl as they sat together upon the water." The writer also endeavoured to shoot several birds with each barrel by this means. On one hunt, he lay behind a driftwood log on the shore and waited for the rising tide to bring in a flock of Pintail ". . . which at Mud Bay equalled in number all other kinds of ducks aggregated." He described what happened when they came within range as follows:

> Carefully aiming at the thickest bunch of birds, I let drive an ounce and a quarter of No. 4 shot, immediately emptying my second barrel in the whole mass of ducks as they rose . . . bringing to bag five and a half couple.

Meanwhile, Gassy Long had shot "a fair bag of duck, and about half a bushel of sandpipers." During the evening flight "the fun got fast and furious."

> As quickly as I could load, I knocked over the ducks, sometimes firing into a lot just pitched on the water, and now and then picking off a single one as they wheeled around. How I did long for a breech-loader! But . . . they were only just coming to the front and I did not believe in their hard-hitting powers, so I had taken out only well-tried ten-bore muzzle loaders; and, after all, I had but little cause to grumble . . . There were five Mallards, eight pintails, two teal, two canvas backs, and a black-and-white duck.

On the second morning, the two hunters set off before sunrise and paddled two miles along the shore to a place where, according to Gassy, geese came to feed soon after dawn. The writer reported that "the commonest kind of goose about Mud Bay was the Canada variety." He used the local names "spur-winged" and "crow-goose". The latter was applied to Taverner's Canada Goose, and the former, presumably referring to the long feathers of the "bastard wing" or *alula*, seems to have been an invention of Gassy's for the larger Canada Geese. Besides these and "two snow white varieties, one having orange-coloured bill and legs and the other very dark grey" (adult and juvenile Lesser Snow Geese), ". . . there were vast numbers of other sorts, such as are found in Europe." Unfortunately, the writer did not specify what these "other sorts" were; perhaps Brant and White-fronted Geese, subspecies of which both occur in Europe.

Having hidden the canoe, the two hunters concealed themselves in a depression at the top of a little mound; ". . . the acre or so of grass around this was of a finer sort than usual, and had evidently been much frequented lately by geese." After twenty minutes:

> We heard some geese coming and presently saw a flock flying just over the water straight towards us. On they came without the faintest sign of suspicion and pitched about thirty yards from our gun-muzzles. There were about sixty altogether, but mostly in

open order in line facing us. So we waited until they got more together and began feeding.

My luck was hardly so good as it might have been. I only killed one with each barrel. But Gassy, who gave the signal, had waited for the moment when the geese arranged themselves on purpose for him. He killed three on the ground and hit another flying . . . (so) we had . . . half-a-dozen fat Canada Geese, averaging between eight and nine pounds apiece.

The writer spent the next three hours wandering along the sloughs where he shot 16 ducks, three snipe and "a white-headed erne or great fish eagle." The death of the eagle pleased Gassy because he stated it was always carrying off his wounded birds. Unfortunately, his knowledge of the fowl in Mud Bay was limited to the price they would fetch in the market. However, the writer identified the following: "mallard, pintail, several sorts of black-and-white and black duck, two sorts of teal, shoveller, scaup duck, canvas back, pochard, golden-eye, buffel-head, American widgeon, scoter, harlequin duck, velvet duck, surf duck, goosander, three sorts of merganser, great northern diver, black-throated, red-throated, and pacific divers (loons), besides puffins, cormorants, and all sorts of gulls, and a small black kind of albatross." The last bird, evidently a shearwater, is a most unusual occurrence on this part of the coast.

The third day's bag brought the total up to almost a hundred and fifty head. These were packed into the canoe and sold in New Westminster by Gassy Long, who spent the proceeds on liquid refreshment in the Royal Hotel. Late in the evening the writer was called away from partnering the Chief Justice, Sir Matthew Begbie, in a game of whist, and ". . . respectfully requested to bail Mr. Longhurst from the lock-up."

Kirly Hare's article gives an interesting insight into the attitudes of the time, not only towards wildlife, but also towards the Indians of the coast, who are referred to throughout the piece with the deepest contempt. For their part, the Semiahmoo, Tsawwassen and Stalo people watched the activities of the white man with a mixture of awe and resentment. They trapped and fished for him, worked in his canneries and logging camps, and helped to build his dykes. But when a settler first shattered the peace of a tree-burial site near the marsh at Westham Island with his fowling gun, he was brought home dead by his brother who was also bleeding from arrow wounds (verbal account by Mrs. Florence Robertson of Delta, 1961).

Soon enough, the Indians themselves had guns and their toll of the waterfowl greatly increased. Simon Pierre of the Katzie recalled that the ducks were particularly easy to shoot before they became aware of the effect of firearms, and he made the exaggerated claim that a hunter ". . . could count out as many shot as he wanted birds, load up, fire into a flock, and bring down one for each shot." (Suttles, 1955). At Sumas Prairie in 1859, John Keast Lord saw how Indians had quickly learned to apply their newly acquired firearms to their traditional methods of hunting White-fronted Geese. He described how they killed "great numbers" from "a kind of lair." (Lord, 1866).

> They arch light sticks by fixing the ends in the ground, just high enough for a man to crawl under, and about six feet long; this they cover with grass, to resemble a mound and rushes; having crept in, the Indian lies still until a flock of geese pitch within shot; then, bowling over as many as he can, he loads again; the geese just circle round and pitch as before, and so he continues to fire until enough are slaughtered; then out he creeps, to pick up the dead and wounded.

White-fronted Geese do not tolerate heavy shooting for long. Both in Europe and America they are regarded by many authorities as the most wary of the geese. In an interesting volume entitled, *Wild Fowl Shooting, containing Scientific and Practical Descriptions of Wild Fowl: their Resorts, Habits, Flights and the most successful Method of Hunting Them*, published in 1888, William Bruce Leffingwell lamented that:

> The White-fronted Geese, at a not remote period were very plenty (*sic*) throughout the West. Their numbers have steadily decreased, going regularly and surely before advancing civilization . . . they are exceeding shy and hard to decoy, usually flying high and pitching down almost vertically, when inclined to alight . . . the hunter will find them wary and hard to get . . . they cannot be found in sufficient numbers to afford amusement to the hunter who is out for success, as well as for recreation.

Throughout their range, White-fronts have made drastic changes in their migration routes and winter distribution when seriously disturbed (Palmer, 1976; Philippona and Labret, 1967).

As the various species of geese in the lower Fraser Valley learned to be more wary fewer were shot, but the harassment continued. Within a few years of white settlement, any human activity on or near the grazing areas was probably enough to put them to flight. The description of the status of the Hutchin's Goose, or Taverner's Canada Goose, at Chilliwack given by Brooks in 1917, is significant:

> Common and at times very abundant but getting scarcer, though few are killed. The vast flocks that used to remain at Sumas Lake and Prairie every fall and spring mostly pass over now, as they are too much disturbed (Brooks, 1917).

A year before, the Migratory Bird Convention had been signed by representatives of Britain (for Canada) and the United States. It included a reduction of the open season from five and a half months to three and a half months, to eliminate spring shooting. But the government of British Columbia refused to shorten its open season and a special clause had to be added to the Convention permitting the killing of wildfowl if they were "seriously injurious to the agriculture or other interests in any particular community." Gordon Hewitt, the Dominion Entomologist, who was Canada's chief negotiator for the Convention, admitted that migratory waterfowl did not constitute a threat to crops but that geese "could be considered injurious" during the northward migration, thus permitting west coast hunters to continue spring shooting (Foster, 1978; Commission of Conservation, 1916).

British Columbia also objected to the clause of the Convention requiring a ten-year closure of hunting on swans, cranes and curlews. This resulted in an amendment of the clause giving British Columbia, alone of all the states and provinces involved, the right to open seasons on these birds. Hunters in British Columbia felt that, in its original form, the Convention would penalize them for alleged depredations of native people in the far north and by Americans to the south. This attitude was reflected in the pessimistic reply written by Allan Brooks to a request for his opinion of the convention. Of swans and cranes in the Fraser Valley he wrote:

> These birds suffer in their breeding haunts in the far north. Few are killed after they migrate. Both must have conditions where they are not much disturbed when at rest, large bodies of water free from pleasure craft for swans and large open plains for the cranes. They mostly pass over their former winter quarters and those they used on migrations formerly, as they are too much disturbed. Protection will not change this (Brooks, 1918).

Even the clause requiring a five-year closure of Wood Duck hunting was unacceptable to British Columbia and Hewitt was forced to wring yet another concession out of the Americans in the form of an amendment permitting the establishment of refuges or "such other regulations as may be deemed appropriate" as alternatives to the five-

year closure. In spite of this special provision, no immediate steps were taken by the province to fulfill its side of the bargain and the Wood Duck only revived in its main nesting haunts in the lower Fraser Valley as a result of the nest-box schemes begun in the early 1960s by the Vancouver Natural History Society and stepped up in the 1970s by the Pitt Waterfowl Management Association. No sanctuaries for Wood Duck, geese, swans or cranes were established by government agencies in the Lower Mainland until 1964, when the Reifel Migratory Bird Sanctuary was set up by the British Columbia Waterfowl Society with the support of the Provincial Fish and Wildlife Branch and the Canadian Wildlife Service. This sanctuary contributed to a revival of the wintering Snow Geese in the early 1970s and also encouraged larger numbers of ducks to remain on the foreshore throughout the winter, but its effect was limited to the bird populations associated with the delta marshes on Roberts Bank (Hoos and Packman, 1974). Elsewhere, the decline of geese, swans and cranes continued unchecked, culminating with the demise of the winter flocks of Brant in the 1960s. The need for sanctuaries, similar to that at Reifel Island, on the other major waterfowl habitats in the Lower Mainland was not given serious consideration until 1977 when a belated attempt was made to revive the wintering Brant on Boundary Bay.

In spite of the lack of remedial action by government, several citizens made local attempts to revive declining waterfowl populations in the 1930s by establishing private sanctuaries, notably George C. Reifel on his estate in Delta, and Oliver Wells on Edenbank Farm in Sardis. Recalling these events, shortly before his tragic and untimely death in 1970, Oliver Wells wrote that after the draining of Sumas Lake and of Indian Prairie, east of Chilliwack,

> . . . the "hunter's paradise" started on its downward run. Hunters became still more numerous. The kill was heavy and the protection afforded by water and cover fast fading away . . . In the fall, no longer are the skies filled with great flocks of ducks and geese (Wells, 1967).

The protection afforded to migratory waterfowl by the tiny twenty-acre sanctuary which he established in 1938 far exceeded his fondest hopes by ". . . increasing the number of birds in the district and in attracting them to remain for longer periods in the valley." Mallard, American Wigeon, Northern Shoveler, Green-winged, Blue-winged and Cinnamon Teal, Wood Duck, Bufflehead, goldeneyes, scaup and Hooded Merganser were identified in ". . . flocks such as had not been seen in years." Two years after the establishment of the sanctuary, 1,500 ducks were coming into its ponds and streams. "Curlew, once common on the farm, but long since forgotten, again appeared." Snipe were seen in flocks of 50 and Killdeer in flocks of a hundred. A Northern Phalarope dropped in. A rail nested in the

marsh, the American Bittern returned, and in 1967 a pair of Green Herons appeared and since then have nested there every year.

In 1945 Allan Brooks visited the sanctuary and renewed acquaintance with the surrounding area where, half a century earlier, he had collected specimens and shot waterfowl as a market hunter. He had changed his earlier views and had already told his friend Oliver that: "Duck shooting might be increased by establishing areas of complete protection for holding birds in the valley. Otherwise (there is) not enough water for loafing grounds (Wells, 1940).

On the coastal foreshores extensive loafing areas still existed, but there too, and on the feeding areas close to them, the need for protection from disturbance became increasingly apparent as human access to the lands and waters south of the Fraser improved.

Between 1881 and 1901, when the human population rose from 6,000 to 52,000, roads and railroads began to match the rivers as major means of travel in the Lower Mainland. According to Ronald H. Meyer, who has traced the history of transportation here, by 1905, after the completion of bridges across the Fraser at Marpole, at New Westminster and at Mitchell Island, "almost every part of the valley was . . . within two miles of a road. Marshy areas, such as Richmond and Delta peat bogs, were the main exception. (Meyer, 1968). Two decades later, following the construction of the Pacific Highway and the draining of Sumas Lake, the grazing geese of the Fraser Valley were deprived of all undisturbed habitat. In 1926 Taverner, in his *Birds of Western Canada*, lamented that:

> One of the greatest enemies of the geese is the automobile . . . its untiring wheels follow the weary feeding flocks from pitch to pitch until, unrefreshed and hopeless of rest, they hurry off on their migratory way, refusing to tarry in the neighbourhood where they are so mercilessly harried.

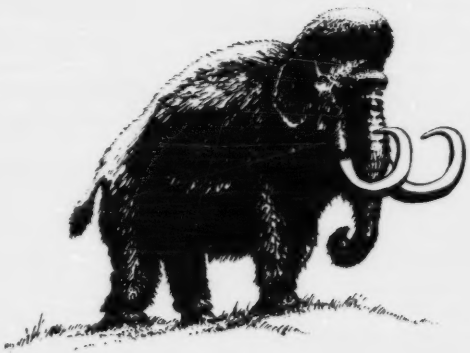
He was referring specifically to the situation in the western prairies, but his words were no less applicable to the coast. Indeed, in 1964, I witnessed just such a motorized pursuit of a flock of Taverner's Canada Geese in the Nicomekl Valley. Three years earlier, the completion of the tunnel under the Fraser at Deas Island and of the freeway to the international border had completed the provision of swift and easy access by car from the city of Vancouver to all the shores of the Lower Mainland.

In spite of its opposition to the closure on swan and crane hunting in the Migratory Birds Convention, the government of British Columbia ultimately changed its policy. But protection came too late to stop a further decline of these birds in the Lower Mainland. The Sandhill Crane population continued to dwindle, and for many years Whistling Swans failed to reappear in their former wintering haunts. Unfortunately, even after receiving legal protection, swans frequently proved to be irresistible targets to unscrupulous or ignorant gunners. In the Arctic, Whistling Swans are still the legitimate quarry of Indians and Eskimos and, since 1962, the state of Utah has issued 1,000 permits each year to hunters to shoot one swan each. As a result, swans have remained restless and wary birds, especially in areas where duck hunting is prevalent. Furthermore, their very size and conspicuous plumage attract human attention, so that they are probably subjected to more disturbance by pleasure boaters and by curious observers on land than the smaller waterbirds. This problem, to which Brooks drew attention in 1917, has grown with the advent of the power boat and the vast increase in boat owners. The loss of habitat in former marshes and lakes of the Fraser Valley has made swans more vulnerable to casual disturbance than ever, so even when they are not hunted, these majestic birds require protection from harassment (Palmer, 1976; Bellrose, 1976; Banko and McKay, 1964).

Allan Brooks attributed the decline both of swans and cranes to similar causes. The fate of the Sandhill Crane does indeed parallel that of the large waterfowl. The Indians respected this "guardian spirit." Their reports and those of explorers and early settlers indicate that it was a common summer visitor to the bogs and coastal marshes of the lower Fraser Valley. Lord, Fannin and Kermode all referred to it as "very common" or "tolerably abundant," but one by one its breeding haunts were vacated until in the mid-1960s only half a dozen nesting pairs were left, five in the Pitt Valley and one in Burns Bog. Very little is known about the impact of hunting upon the cranes in the Fraser Valley. They were regarded as game and, like the swans, offered a large and tempting target to pioneer hunters. Oliver Wells recorded that the pioneers on Sumas Prairie called them "wild turkeys" and ". . . thought favourably of them, for they bothered no one and were good eating" (Wells, 1967). The decline of the Sandhill Crane may well be a

continuing result of the high mortality suffered by these birds in the 19th century after white colonization. Like the swans, cranes were finally afforded protection after the Migratory Bird Convention of 1916, but by that time their surviving local breeding populations had become small and isolated. Since then they have proved incapable of restoring a viable level of numbers.

In the late 1970s the decline of water quality, fish and wildlife in the lower Fraser was fully recognized, and efforts are now being made to find means of reviving the natural systems of the river. Is it possible, after a century and a half of habitat destruction and disturbance, to restore, at least in part, some of the depleted populations of waterfowl on the river marshes? Experience elsewhere suggests that this can be done if the traditional needs of the birds are met once again in habitats on the lower Fraser. But first we have to understand the nature of those habitats and of the traditions that have evolved with them since the last Ice Age.



2. The Creation of the Marshes

Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven.

Genesis 1:20

The marshes of the Fraser Delta are the creation of mountain, glacier, tide and river. The ice came nearly two million years ago, in the Pleistocene epoch when mammoths, mastodons, camels and wild horses roamed North America. There were several successive glaciations. During the last the edge of the Cordilleran ice sheet buried the delta marsh and compressed the land under its weight, for its ice was five thousand feet or more thick. About 18,000 years ago the ice sheet began to melt and divide into glaciers which ground their way imperceptibly among the mountains. For 6,000 years the ice masses met, interlocked, groaned, cracked and tilted into the sea. As the climate became warmer, the ice melted leaving a great depression that men today call the Strait of Georgia. Salt water then invaded the valley between the Coast and Cascade Mountains, gnawing at the ice that emerged from the protective fiords. The dying glaciers left their burdens of rock in the waters. Slowly, as the land rose, freed from the awesome weight of ice, rock and gravel moraines emerged as islands. Through the centuries the tides and torrents from the mountains added piles of gravel and silt to the floor of the valley. At first the sea reached deep into the land from Boundary Bay to Pitt Lake and from Bellingham Bay to Agassiz. As these broad embayments became silted

up it is possible that the Pitt River flowed into Burrard Inlet and the Fraser into Bellingham Bay (Hoos and Packman, 1974; Western Canada Hydraulics Laboratories, 1976).

Then, about 12,000 years ago, the ice advanced again. From the Stave and Harrison Valleys glaciers extended a dam of ice across the Fraser. When it thawed the waters found their present course north of Sumas Mountain, leaving Bellingham Bay to the Nooksack River. An isolated remnant of the ice dam sat melting in a broad depression in the centre of the valley and formed Sumas Lake. Glacial outwash and sand deposits filled the Boundary Bay-Pitt Lake embayment, leaving its southern half drained by two small rivers, the Serpentine and the Nicomekl (Mathews, 1977).

The landscape which emerged from the salt waters was a vast wreckage of boulders, gravel piles and shifting silt. Yet with all the persistency of unlimited time, life was carried by the waters and the wind, stirred within the soil and crept back upon the face of the land. First came plants, fish, insects and birds. Mammals followed later. They came from lands to the south which the glaciers had failed to reach, and edged their way northwards into the new territory left by the retreating ice. For several small mammals, the Townsend vole, Townsend chipmunk, and the mountain beaver, the Fraser River was an insuperable barrier and has remained so till this day. Others succeeded in crossing the river but were contained by Burrard Inlet, which still marks the northern limit of their distribution (Cowan and Guiguet, 1960).

Among the more mobile mammals were men. A pebble-tool folk established themselves on terraces in the Fraser Canyon about 11,000 years ago when there were still great blocks of ice on the Fraser lowlands (Borden, 1968 and 1977).

After its diversion by the Sumas ice dam, the Fraser River began to build a new delta north of its old ones in Bellingham and Boundary Bays by filling with sand and silt the area between the uplands of Vancouver and Surrey and the island now known as the Point Roberts peninsula. The process began scarcely 7,000 years ago, for only the most easterly part of Lulu Island carries deposits of ash from the great volcanic eruption at Crater Lake, Oregon, which occurred at that time.

The new delta was a shifting expanse of tidal flats and salt marshes cut by estuarine channels and backed by brackish marshes and wet meadows. Its plant life was probably similar to that which can be seen in the delta marshes today (Forbes, 1972; McLaren, 1972; Watmough, 1972). On the outer shore of the intertidal zone bulrush is the dominant growth; most of it is three-square bulrush, but roundstem bulrush and prairie bulrush are also found there, and on the larger hummocks Lyngbye's sedge. (The scientific names of species mentioned in this

book are given after the common names in the Index). Closer to the shore the sedge becomes dominant with clumps of reed fescue, bent grasses and tall hair grass growing amongst it. As the ground rises the dominant plant is the cat-tail or great reed mace, often wrongly called "bulrush". Its reed-like growth covers large areas along the shore, but where its stands are thin, water plantain, Lyngbye's sedge, Douglas aster, purple loosestrife and reed fescue also thrive.

As the alluvial deposits of silt, sand and mud formed higher lands in the delta, grasses spread across those places beyond the reach of daily tides. The growth of shrubs and trees was prevented by the floods which still took place with the spring tides. (These tides have nothing to do with the season of spring; their name is derived from the Anglo-Saxon word *springan* meaning to rise. They occur every two weeks when the sun, the moon and the earth are aligned.) The grasslands were also flooded by the heavy rains of winter, draining away slowly because of the high ground-water table, especially in fine textured soils. In summer came the greatest flood of all, the annual freshet of melt water from all the mountains drained by the Fraser in its journey of 1,365 kilometres to the sea.

The natural grasslands of the delta have now been dyked and cultivated so we can only guess what plant species grew there. The few remaining marginal areas are of little help because they have been invaded by introduced species of grasses and weeds from the agricultural lands (North and Teversham, 1976).

In spite of the floods the delta was not entirely devoid of trees. Along the larger channels thicker deposits of sediments built up high banks. Wave action on the open shores created beach ridges. Such elevated places gave footholds for willows, Pacific crabapple, northern black cottonwood and Sitka spruce. Later these isolated clumps of trees became landmarks used by fishermen navigating the mouth of the river.

Much of the delta was hardly navigable even to the canoes of its first human inhabitants. The heavy growth of the shallow marshes became a trap for plant debris carried by the river. Entire trees and tangled masses of shrubs dislodged by landslides or uprooted by erosion were deposited together with the dead plants of the marsh itself. Large static bodies or organic material became bogs, by-passed by the estuarine waters and saturated in the humic acid produced by their own arrested decomposition. Here grew only the bog plants, sphagnum moss, cotton-grass, blueberry, huckleberry and Labrador tea.

Further up the valley, beyond the delta marshes and bogs, the mild climate fostered a heavy growth of plants. Swampy areas of coarse grass and hardhack, interspersed with clumps of trees, merged into

wooded swamps of red alder, vine maple, and broadleaf maple, with a carpet of yellow arum or skunk cabbage. On well-drained hills the deciduous trees were succeeded by great forests of Douglas-fir, western hemlock and western red cedar.

While the new delta was slowly beginning to form, the old one in Boundary Bay was rapidly changing. The quantity of fresh water flowing out of the Serpentine and Nicomekl Rivers was not sufficient to maintain the great estuarine marshes of cat-tail, bulrushes and sedges created by the Fraser. Instead the resulting salt water fostered the growth of eel-grass, sea-lettuce and other primitive algae which formed a green carpet on the tidal sands. Glasswort, sea blight, sea plantain and various salt grasses grew along the shore. This change from a fresh or brackish water community to a saline one increased the variety of habitat on the delta. Further diversity was added by the rocky shores and shallows below the steep bluffs at Point Grey, Point Roberts, Kwomais Point and Semiahmoo Bay, and by the three large fresh marshes located upstream in the flood plain at the confluences of the Fraser with its tributaries, the Pitt, the Sumas and the Chehalis Rivers.

The Pitt flows into the Fraser only 30 kilometres upstream from the sea. Here, over the centuries, the shifting confluence formed two large deltaic islands and a flat apron of marsh and swamp on the south shore of the Fraser. On the north shore the flat plain between the two rivers and Pitt Lake was a maze of streams and sloughs winding through marshes, peat bogs and meadows.

Fifty kilometres further up the valley, in the alluvial plain between the Fraser, Chilliwack and Sumas Rivers, lay another wide fresh-water marsh and open grassland. The western end of the plain gently sloped into Sumas Lake. Each summer, when the Fraser River rose, its waters reversed the flow from the lake and flooded the entire plain. During the winter the lake became shallow and in periods of little rain it was

hardly more than an expanse of open mud. Its fluctuating water levels evidently discouraged the growth of water plants, but its very open character beside the lush prairie intersected by many winding sloughs, made it a safe habitat for waterfowl and shorebirds (Lord, 1866; Brooks, 1917).

A third area of inland marsh lay between the confluences of the Chehalis and Harrison Rivers and the Fraser River. The delta of the Chehalis, with its floodplain and adjoining forested uplands, has retained its natural character and enables us to see today the kind of wild marshland which once characterized much of the lower reaches of the Fraser and of its tributaries. Sedges and other aquatic plants thrive in the marsh. The floodplain contains stands of large cottonwoods and willow. Spectacular out-croppings of moss-covered rocks add a romantic effect to the landscape. The surrounding mountain sides are clothed in mixed woods, topped by second-growth Douglas-firs and red cedars. It is still a gathering place, not only for waterfowl, but also for gulls and Bald Eagles attracted by the dying salmon which choke the waterways after sprawning (Benn and McLean, 1977).

In the 130 kilometres between the Fraser River's emergence from the Fraser Canyon and its meeting with the sea the changes that followed the retreat of the glaciers created a landscape of such diversity and richness that it offered winter feeding opportunities for almost every kind of waterfowl on the Pacific Flyway. However, for most waterfowl the lower Fraser Valley was not a favourable nesting area. The very spring floods and freshets which maintained the larger marshes prevented the ground-nesting ducks from finding suitable breeding habitat in the floodplain or along the tidal shores. But smaller marshes and bogs isolated from the rivers, often at higher elevations, with their water levels regulated and maintained by beaver, offered nesting sites for Mallard, and Green-winged, Blue-winged and Cinnamon Teal.

Tree-nesting species like the handsome Wood Duck and the Hooded Merganser were more widely distributed along the wooded banks and backwaters of the rivers, and on the lakes, ponds and streams kept open by the beavers. They found nesting sites in holes bored in downed alders and cedars by Pileated Woodpeckers and Flickers. Higher in the mountain streams inconspicuous female Harlequin Ducks raised their broods while their gaudy drakes returned to the rocky shores of the strait to moult.

So there was a small traditional nesting population of ducks in the lower Fraser Valley. But by far the strongest traditions of waterfowl were in the use of the marshes as a stopping place or wintering area on their great migratory flights to and from their Arctic and prairie breeding grounds.

3. The Annual Rhythm

"First we feel it stirring within us, a sweet unrest; then back come the recollections. . . . They flutter through our dreams at night, they fly with us in our wheelings and circlings by day . . . as one by one the scents and sounds and names of long-forgotten places come gradually back and beckon to us."

Kenneth Grahame,
The Wind in the Willows, 1908

The migration of birds has always been a mystery. In order to understand it better, scientists put numbered metal bands on the legs of young birds before they can fly, or on adult birds caught in nets. If these are recovered when birds are shot by hunters, or found dead, they give some idea of the travels of their wearers. Banding has added much to our knowledge and also to our sense of wonder at the distances covered by these frail and comparatively unintelligent creatures. Waterfowl seen over the Fraser Valley in the fall may have come from beyond the Arctic Circle. Some spring migrants could have been in Chile, Brazil or Mexico only a few days before, and others might have some island off the coast of Siberia as their destination. But although we now know more about the length and duration of migratory flights, so far no one has been able to offer a completely adequate scientific explanation of how birds navigate or how migration began and evolved.

The simplest answer to the problem of bird navigation is that, like most other travellers, migrants find their way by using landmarks. The view from an aircraft at an altitude of a thousand metres gives some idea of the range of vision encompassed by birds on high migratory flights. They are able to use clues in the landscape, and may even interpret details of seascapes, the pattern of waves, currents and clouds, as aids to navigation. Experiments have shown that they also use heavenly bodies to find direction. Living under the open sky by a fairly strict time schedule of daily activity, they possess an awareness of the arcs followed by the sun and other stars. These they can use to determine their position in relation to their "home" habitat. Perhaps this sort of orientation contributes to what we vaguely call a sense of direction (Hochbaum, 1955; Matthews, 1968; Bellrose, 1976).

Some scientists believe that when such visual aids are not available, due to cloud or fog, migrating animals can use the earth's magnetic field as a guide. However, birds appear reluctant to rely on this alone and often abandon migratory flights if visibility is poor. Sometimes fog confuses them so badly that they fly towards man-made sources of light such as brightly lit buildings, lighthouses, airfield landing lights or even, as I recall on one occasion, the illuminations of a fun-fair.

The origin of migration is also the subject of several theories. Although we will probably never know exactly how migration first began, the observation of birds today provides a working hypothesis about the evolution of migration in the distant past. In order to survive every animal needs an environment in which to safely feed, rest and reproduce. Often these activities require different habitats so the ani-

mal must move from one to another. The power of flight enables birds to undertake frequent journeys between their feeding, resting and breeding habitats. During the long and gradual geological and climatic changes on earth many types of prehistoric birds must have extended their flights from one habitat to another until they evolved into major seasonal movements or migration similar to those that form part of the behaviour patterns of species existing today.

The migratory movements of the majority of waterfowl to the open prairies and Arctic tundras are mainly a response to the need for secure habitat in which to nest, raise young and moult. The need for moulting habitat is often overlooked because most birds change their flight feathers only one or two at a time and so do not lose the ability to fly. But ducks, geese, swans, grebes, loons and coots drop all their primary feathers at once and therefore require large expanses of marsh or water in which they can evade predators and find nutritious food while the new pinions grow. Geese moult their wing feathers when the goslings are still unable to fly. The fact that both adults and their young share the same vulnerability for several weeks may strengthen the family bond in geese, for they tend to stay together even until the following spring, when the adults breed again. In contrast, the males of most ducks moult while the females rear their broods. Only when the young are able to fend for themselves do the females moult. So, by the time the juvenile waterfowl have strengthened their wing muscles and learned to fly, and the last of the adults has completed the moult, summer is coming to a close and the family has dispersed or has lost its identity in large flocks.

Obviously, the most compelling reason for migration from the northern breeding grounds is the freezing of the waters and marshes. But many waterfowl depart long before their food supplies are depleted or inaccessible. No single factor triggers the departure, but the shortening of the days and accumulation of fat reserves on the bird are both important influences. Favourable winds also encourage birds to migrate, and adverse winds delay departure, especially of birds setting off over the open sea. Usually the migrants depart in the evening or at night.

In North America, waterfowl migrating from the Arctic tundra may stop in the grasslands and marshes of the prairies or in the interior plateaus of British Columbia. Here other ducks and geese have bred and moulted and are preparing to fly south. Finally, they move in their millions down the four great flyways to their winter ranges.

The Atlantic, Mississippi, Central and Pacific Flyways should not be regarded as migratory routes but rather as administratively convenient divisions with only a limited biological significance. They divide North America into four regions containing states and provinces which

can effectively work together in defining management policies for the migratory birds which move up and down the length of the continent (Linduska, 1964). The migratory flights of many birds takes them out of one flyway and into another. Migrating birds do not habitually converge on narrow routes defined by recognizable geographical features like rivers. Sea coasts and mountain ranges may cause a concentration of migrants and some mountain passes certainly do. But observations, especially by radar, of migratory movements indicate that most of them take place on broad fronts down corridors following fairly direct courses between major resting places, or staging areas, and the breeding or wintering areas (Bellrose, 1976).

The biggest migration corridors of waterfowl in the Pacific Flyway by-pass the forested inner coasts of British Columbia and Vancouver Island and converge from the ocean and from the interior valleys on the national wildlife refuges at Lower Klamath and Tule Lake in Northern California. Here, during the peak of the migrations in spring and fall, occurs one of the biggest concentrations of waterfowl in North America. By midwinter some 700,000 geese and four million ducks have spread south through the Sacramento-San Joaquin and Imperial Valleys of California. Most of the remaining 200,000 geese and two million ducks on the flyway are distributed throughout wintering areas in six other western states. These include the wetlands, lakes and grainfields of the Columbia Basin in Washington and the salt marshes, coastal shallows and deltas of Puget Sound and the Strait of Georgia. Some of the migration corridors to these important places cross the Fraser delta and so bring thousands of migrants to fill its marshes in the spring and fall. Many remain throughout the winter because the weather is usually so mild that feeding areas on the coast remain unfrozen.

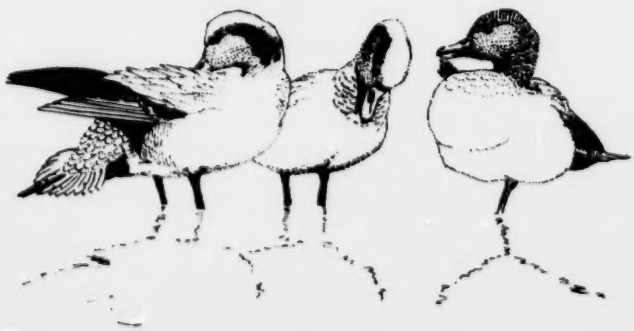
The main requirement of waterfowl in their wintering areas is undisturbed habitat for feeding. This includes the taking of grit, because small stones are essential for the gizzard to grind up food to prepare it for efficient digestion. Waterfowl feeding in the loamy soils of marshes and floodplains, or on the mud flats, must fly to places where they can find grit, usually to beaches or banks of silt and gravel on rivers and estuaries. It is tragic that in many marshes subject to intensive shooting, feeding waterfowl pick up lead pellets, mistaking them for grit, and later die of lead poisoning, which is conservatively estimated to kill two to three per cent of the fall and winter waterfowl population of North America (Bellrose, 1964; Bellrose, 1976; Bellrose and Sanderson, 1977).

The importance of loafing habitat must also be stressed. The term "loafing" includes not only resting, sleeping, and dozing, but also preening. All birds have to preen in order to keep their feathers clean, unmatted and waterproofed. This ensures the efficiency of their flight

feathers and also of their body plumage in its task of providing protection from extremes of climate. As they preen, birds take into their bills a small quantity of oil from a gland protruding just above their tails. A film of this oil adheres to each feather as it passes through the bill of the preening bird. The tips of the oiled feathers form a waterproof outer layer like the visible ends of shingles on a roof. Underneath, the downy part of each feather contributes to a warm under layer. In cold weather the bird can increase the thickness of this under layer by fluffing up its feathers. In hot weather it does the reverse and flattens its plumage so that the warm layer is reduced.

Birds which swim obviously require a higher degree of waterproofing than land birds. Their oil gland is larger and they have to spend more time ensuring that the outer layer of their feathers is completely sealed against leaks. The penetration, even of a small amount of cold water, would cause a matting of the under plumage leading to chilling and death. So, every day waterfowl spend many hours preening. Their very survival depends upon it.

While engaged in preening they are quite vulnerable. Their heads are constantly moving in and out of their plumage and their attention is focussed upon their feathers. So they prefer to do it in the same sort of place that they pick for sleeping and dozing. Many waterbirds, especially the pelagic species which spend most of their lives on the open ocean, and also the grebes, loons and some of the diving ducks, preen on the water, turning on their backs to oil their underparts. But most waterfowl prefer to preen out of the water standing on open shores, beaches, mud flats, sand banks, logs, rocks or driftwood. Such places are second in importance only to feeding grounds in their cycle of daily living. Large areas of suitable feeding habitat throughout the world are left unused by waterfowl because they are not matched by adequate loafing habitat to which the birds can withdraw for undisturbed security.



4. Legacy of the Ice Age

. . . (The) passing of geologic time involved many millions of years, and the Ice Age, ancient though it may seem, is but seconds away by comparison. You might even say it is an event of the day, because half the ice (Greenland and Antarctica) is still present. And men and mallards were around throughout its last southward thrust.

C. H. D. Clarke, 1964

The landscape shaped by the retreating glaciers 11,000 years ago provided a choice of different habitats for a wide variety of waterfowl. There were places for the ducks that "dabble" in the shallows, for those that "dive" for their food to the bottom, and for the "saw-bills" that catch fish. Swans found habitat in the river back-waters, lakes, and estuaries; and geese found their feeding areas, some on the tidal shores, and others on the wet meadows between the marsh and the forest.

Like the landscape, the animals that arrived to live in it were a product of the great Ice Age. The evolution of existing birds, including the waterfowl, is thought to have taken place in the last two million years, at the end of the Pliocene epoch and throughout the Pleistocene epoch. The most recent glacial advances across the land masses of the Northern Hemisphere helped to determine the evolution, migratory traditions and distribution of the species and subspecies of waterfowl seen in the Fraser Valley today.

A species is defined as "an evolved (and probably evolving), genetically distinctive, reproductively isolated, natural population" (Boyd, 1972). Species are grouped into a larger unit called a genus

following the system invented by the great Swedish naturalist, Carl Linnaeus, each species having an international scientific name in Latin or Latinized Greek. The first word of the name is that of the genus, the second is that of the species. When there is a third word, it names the subspecies or race. Most species of waterfowl in North America probably evolved in the last Ice Age. The differences between closely related subspecies often seem slight, and they have sometimes provoked long and bitter disputes between professional ornithologists. Taxonomy, or the process of classification, is a science; but, as one authority has admitted, it is also a game in which the outcome depends upon the weight of opinion in one of two rival groups of taxonomists, the "lumpers" and the "splitters" (Boyd, 1972). Recently the lumpers have been in the ascendancy and complex divisions of subspecies, like those of the Canada Goose, are now being simplified. In this task, taxonomists are greatly helped by informed guesses about the effect of the Ice Age upon the evolutionary process.

The evolution of subspecies is most prevalent in birds like cranes, geese and swans which pair for life and remain in family groups of adults and young for much of the year. Several family groups form into flocks which migrate and remain together until the following spring when they return to the vicinity of the breeding area in which they were hatched. Many ducks also return to the place in which they first learned to fly, and females often return to nest in the same area of marsh throughout their lives. But, in contrast to the geese and swans, large numbers of ducks join flocks or pair with mates which draw them off to totally new parts of their breeding range. Thus, there is constant interchange of genes which discourages the development of distinct traits leading to evolutionary change. Wide-ranging species of ducks like Mallard, Pintail and Northern Shoveler have uniformity of behaviour, plumage and structure across the Northern Hemisphere. In contrast, most species of geese, with their family bonds and comparatively strict adherence to the same annual migratory pattern, have several subspecies or races which are the result of the in-breeding of isolated nesting populations.

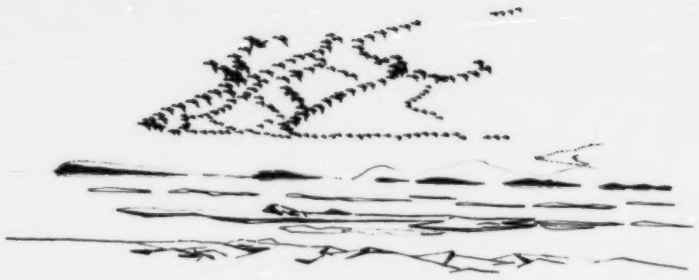
At the height of the last Ice Age, or the "glacial maximum," much of the Arctic tundra, which now provides breeding habitat for great numbers of waterfowl, lay under the ice sheets. However, considerable expanses were left uncovered due to the effect of dry winds on the snowfall. These areas provided "refugia" in which many species of Arctic wildlife survived. The largest of these refugia was located in parts of central Siberia and extended more or less intact across an area now called Beringia—comprising eastern Siberia, Alaska and that part of the bed of the Bering Sea then exposed by the low sea level. Another called Banksia included Banks Island and part of the most northerly of the central Arctic islands of Canada. A small refugia also existed on the

northern coast of Greenland. Migratory waterfowl continued to nest in these places, while other populations of the same species bred on the tundra zone south of the ice sheet. The isolation of the breeding populations of geese had varied effects. The northern nesters became smaller, perhaps due to the shorter northern summer which gave them a limited period in which to attain full growth. They also undertook longer migratory flights, not only crossing the ice-sheet, but "leap-frogging" their larger equivalents from the southern tundra zone, probably in order to reduce competition with them for food in their winter range. The geese which nested still further south in areas with mild climates tended to become large and sedentary, staying in the same place all year round (Palmer, 1976).

Since the last glaciation the waterfowl in the northern refugia have generally extended their breeding ranges laterally along the coasts and southward into the uncovered tundra. Populations south of the ice sheet have followed its retreat northward and established breeding areas in the exposed muskeg and tundras. In some cases northern and southern populations met and intermingled, making the task of the taxonomist more difficult. Nevertheless, we now have an acceptable hypothesis for the evolution of several species and subspecies of water birds as a result of the geographical isolation of breeding populations during the Pleistocene epoch.

The Canada Goose provides a clear example of this evolutionary process which divided it into many races. During the last glacial maximum it is likely that the Canada Goose was distributed in a number of separate breeding areas north and south of the ice sheet. Those to the north became the small Richardson's Canada Goose, the Cackling Canada Goose, and the rare Aleutian Canada Goose, that weigh less than four pounds. As the ice sheet melted the geese nesting south of it shifted northwards to occupy breeding habitats on the tundra and muskeg. Those that went furthest north became the medium-sized subspecies, the Lesser Canada Goose and Taverner's Canada Goose, weighing up to six pounds. The more sedentary subspecies, the Western or Great Basin Canada Goose and the Giant Canada Goose, centred on the prairies, were characterized by their greater size, the latter reaching over 12 pounds (Palmer, 1976; Bellrose, 1976).

The same process of the evolution of subspecies through geographic isolation during the last glacial maximum had similar effects upon other species. Discrete breeding populations of the White-fronted Goose formerly scattered across the Arctic refugia were probably the origin of the three subspecies generally recognized today: The Eurasian, Pacific and Greenland White-fronted Geese. A very large form of White-front, regarded by some authorities as a fourth subspecies, is the Tule Goose, which winters in California. Like the largest



Canada Geese, it may be the result of a population which formerly nested south of the ice-sheet (Elgas, 1975; Palmer, 1976). The division of the Lesser and Greater Snow Geese and of the Pacific (Black) Brant and the Atlantic (or light-bellied) Brant may also be traced to the last glacial period.

It is possible that the same situation in earlier ice ages resulted in the evolution of the Trumpeter and Whistling Swans and Greater and Lesser Sandhill Cranes as separate species and subspecies. In these cases too, the smaller birds nest further north and leap-frog their larger relatives when they fly to their wintering grounds.

The shift and spread of the summer and winter ranges of migratory water birds on the Pacific Flyway has been a major factor determining their status in the Fraser Valley. As already described, the retreat of glacial ice from the lower Fraser Valley exposed a landscape of varied habitats, many of them attractive to wintering water birds and some suitable as breeding areas for certain species. The use of the delta and valley marshes by waterfowl may have increased during a period of warm, dry climate which began about 7,500 years ago and lasted for over 3,500 years. During this period, Lake Bonneville shrank from the size of Lake Michigan into the present Salt Lake, and other wetlands between the Sierras and the Pacific may have dried up altogether. As a result, the wintering ranges of the Arctic breeding species may have extended further north than they do today. Similarly, several species which now nest further south or east may have bred in the Fraser Valley. Since the return of a cooler, more humid climate, the waterfowl population has probably differed little in status and distribution from that found by the first white settlers in the nineteenth century.

Evidently the various species which formerly nested in the tundra south of the ice sheet spread northwards as the ice retreated. The Greater Sandhill Crane probably extended its range along the coast both on the mainland and on the islands. However, we cannot tell whether the Dusky Canada Goose once nested on the shores of Vancouver Island, where today it makes a migratory stopover, or on the Fraser River's marshes, before it moved further north into its present range. It is also possible that the Great Basin Canada Goose extended its range westward to the coast during the dry period of 3,500 years and withdrew to its present range east of the Cascades when the cooler, more moist climate returned about 4,000 years ago. However, there is little reason to suppose that this goose has any recent nesting tradition in the lower Fraser Valley. The Trumpeter Swan has extended its breeding range northwestward since the glacial retreat, but it probably remained in the eastern parklands of British Columbia and reached the coast first in Alaska, then spread southward from there into northern British Columbia. So it is likely that both the Great Basin Canada Goose and the Trumpeter Swan have been only winter visitors to the lower Fraser in the last 4,000 years. The Cackling Canada Goose and the Lesser Sandhill Crane have probably always leap-frogged this area as they do today, but others, including the Whistling Swan, Taverner's Canada Goose, the Pacific White-fronted Goose, the Lesser Snow Goose, two distinct populations of Brant and many species of ducks, all had traditional winter habitat or spring and fall stopping places on the lower Fraser.

Each species found the place that best-suited its needs for food. The outer marshes of the delta on Roberts and Sturgeon Banks, and the deltaic islands, provided bulrushes for the Lesser Snow Goose and sedges for the Mallard, Pintail and Green-winged Teal. On the tidal flats of the old delta in Boundary Bay the eel-grass attracted the Brant and, where the estuaries of the little rivers drain into Mud Bay, dabbling ducks, especially Green-winged Teal, gathered each fall. The foreshores of the delta and the bay provided secure roosts for the grazing geese, the swans and the widgeon that flew into the marshes and wet grasslands to feed. Similar gatherings of Canada Geese, White-fronted Geese, Whistling Swans and dabbling ducks found both loafing and feeding areas in the fresh-water marshes and sedge meadows of Sumas Lake, the Pitt River, and the Chehalis River. The deeper coastal and estuarine waters provided habitat for a varied array of diving ducks including scaups, goldeneyes, scoters and mergansers. Each found its place in the pattern of life on the delta.

5. The Dream Time

Khaals said,

'I have created for your food also ducks and geese and swans. Bring me now some sticks, and I will show you how to make snares for catching them.' After he had set some snares, and shown them also how to make and use a duck net . . ., he said: 'Sensible Indians shall learn from you how to make similar snares and nets.'

The Katzie Book of Genesis
(Jenness, 1955).

In Australia the time of the aborigines is called the "dream time," for it was a time with myths but no history, with nature but no science. The aboriginal people of the Americas also had their dream time, few more so than the tribes of the northwest coast who lived in a land of mild climate and of plentiful foods. They enjoyed a state of harmony and balance with their natural environment, neither depleting the resources on which they depended, nor losing respect for the bounty which sustained them. This may not always have been so. Some scientists believe that the earliest phases of man's invasion of North America were characterized by predatory activity which hastened the adverse effects of climatic changes on the Pleistocene fauna of the continent.

Stone-age man probably arrived in North America by following the herds of grazing mammals aross Beringia and up the Mackenzie Valley. This movement was followed by the rapid extinction of more species of mammals and large birds than at any period of comparable

climate in the million years of Pleistocene epoch. Palaeontological studies have revealed that in the last 32,000 years of prehistoric time 60 species of mammals and 33 species of birds have become extinct (Fisher, 1970). They include eight species of bison, seven of horses, six of mammoths, four of antelopes, three of ground sloths, two of bears, a giant beaver, a tapir, a llama, a camel and a mastodon. Among the birds were two species of flamingo, a stork, a wood ibis, a turkey, and two waterfowl—the Graceful Goose *Anabernicula gracilenta*, and Law's Flightless Scoter *Chendytes lawi*—both of which were inhabitants of California. A large number of the extinct creatures were predatory mammals and birds, many of them giant species like Merrian's Teratorn, one of the largest birds that has ever lived. They probably disappeared when the herds of large herbivores on which they depended for prey or carrion were decimated. The peak killing period was apparently between 14,000 and 8,000 years ago, perhaps caused by human hunters. As the mammoths, horses and camels were eliminated, the hunters seem to have concentrated on Taylor's Bison and the huge Ancient Bison of the high plains. When these species became extinct about 9,000 years ago they turned to the Western Bison, a somewhat smaller animal which they learned to stampede into narrow gulleys or over the cliffs. After another thousand years the Western Bison was also gone from the plains. Gradually many hunters turned to smaller game and in the east and southwest they made slow transitions to the cultivation of crops. On the prairies nomadic hunting bands preyed largely on the huge herds of the surviving bovine species, the American Bison.

Meanwhile, in the far west the hunting bands moved northwestward into new lands exposed by the thawing Cordilleran ice sheet. Perhaps by following the Columbia River, or by crossing the passes of the Cascade Mountains, they reached the Puget Lowlands and settled on the many rivers—the Nisqually, Puyallup, Snoqualmie, Skykomish, Stillaguamish, Skagit and Nooksack. Eventually, between 10,000 and 11,000 years ago, they reached the Fraser Canyon (Borden, 1966; Borden, 1977).

The new arrivals probably relied upon the salmon for food only during the major runs of fish, hunting mammals and birds and gathering berries and roots during the rest of the year. But as they moved from the canyons and from the mountain reaches of the rivers to the floodplains and deltas, they spent less time hunting mountain goat, coast black-tailed deer, black bear and beaver and devoted more time to fishing and fowling in the marshes (Borden, 1970; Calvert, 1970).

The people of the lower Fraser established villages in sheltered places where the forest met the water. Each year they moved to various temporary camps for particular seasonal gathering and fishing activities. On the delta they fulfilled the urge to take larger quarry by

hunting the sea mammals, especially the hair seal and harbour porpoise. The killing of the huge White Sturgeon was hardly less of a challenge, for these fish could be up to 6.5 metres long and could weigh half a ton. But the capture of large mammals and fish was not the only test of these stone-age hunters. The presence of discarded bird bones, and of needles and pins made of such bones, among the artifacts excavated at an archaeological site on the coast of Vancouver Island confirms that fowling was also an important activity. On Vancouver Island the most common goose bones were those of Canada Geese, but those of Brant and White-fronted Geese were also found, as well as those of Whistling Swans and Sandhill Cranes. But the remains of ducks were far more numerous, with diving ducks greatly outnumbering the dabbling ducks (Borden, 1962; McMillan and St. Claire, in press). Bones of White-fronted Geese were also found at Crescent Beach and those of Brant, at the Glenrose Cannery site on the lower Fraser (Ham, 1982; Matson, 1976).

As the delta's shoals and marshes spread westward the Coast Salish Indians occupied the Fraser River's lowland shores beyond the canyon and became known as the Stalo Prole, the River People (Duff, 1952; Suttles, 1955; Jenness, 1955). During their centuries of adaptation to life on the marshes and shores of the Fraser and its tributaries, the Stalo and their neighbours on the strait developed a variety of devices for taking waterfowl. The simplest was the fowling spear tipped with up to five diverging, barbed prongs of deer or swan bone. The more skilled duck hunters placed the barbs outwards so that they caught the feathers and did not tear the flesh of the quarry. Duck arrows resembled the spears and sometimes had retrieving lines attached (Duff, 1952; Barnett, 1955).

In order to get within easy range of ducks, the Stalo people often hunted at night in a two-man canoe with a small bright fire burning in a hearth on the bow. The hunters crouched in the shadow of a mat hung amidships. When approached on the water, ducks tended to swim into the shadow cast by the mat and the canoe where they were speared.

On very dark, stormy nights the ducks showed a marked hesitation to fly and the hunters sometimes caught them by hand, though they usually used hand nets or throwing nets of five-inch mesh, mounted on rectangular wooden frames of four poles each two or three metres long.

This method of hunting was employed by the Tsawwassen and Lummi Indians on the mainland coast, and by the Indians on the shores of Vancouver Island, to catch Brant as well as ducks. The following passage gives an eye-witness description of a Brant hunt near Fort Rupert:

> A dark, wet, still night is chosen in the winter when the Geese are feeding on the beds of *Zostera* in shallow water. Two Indians go out in a canoe, one in the bow armed with a torch of resinous pine splinters known as a "gum-stick", and a large net like a landing-net on a pole; the other sits in the stern and paddles the canoe in the direction of a flock of Brant. As soon as the canoe has got in amongst a flock the torch is suddenly lighted and as suddenly extinguished. The birds at once get up and fly about a short distance but settle again as soon as the light disappears. The Indians mark the direction taken by the birds and follow them, again paddling noiselessly into the flock. The torch is again lighted and extinguished with the same result. After this manoeuvre has been repeated some three times the geese become bewildered. When the torch is lighted they do not attempt to fly but stay and gaze at it. They are then quickly scooped out of the water by the Indian with the net (Sprot, 1928).

A resident of Ucluelet described a similar tactic employed on stormy nights by the Indians on the west coast of Vancouver Island at Toquart. They used two canoes with fires on their prows and a net between them which was dropped on the Brant huddling together in confusion. Unfortunately, there are no records of the methods used to catch Brant on the lower, mainland coast but it seems likely that netting at night was widespread because it proved to be the only successful method of taking these birds in open water.

The Stalo also used hand nets, while standing in tall grass or reeds, to catch low-flying fowl by day. Stressing the richness of the wildlife populations in his youth, Simon Pierre, an old member of the Katzie band which lived between Pitt Lake and the Fraser River described hunts when "waterfowl were so plentiful that they could easily be shot with bow and arrow." He described how his grandfather shot swans with arrows three feet long, armed with twin points of bone, and told how the huge birds would sometimes fly off though pierced by such an arrow (Suttles, 1955).

Among the early accounts of Indian hunting methods are a number of curious claims by Stalo, Squamish and Sechelt Indians that low-flying ducks could be brought down by means of loud shouts. Some

stated that the ducks dropped dead, others that they were only temporarily paralysed (Duff, 1952). It is possible that a sudden sharp cry might have caused fast-flying flocks of teal, wigeon or shorebirds to swoop low or swerve into nets, for, in addition to underwater nets set for diving birds, the Indians of the coast and lower Fraser made use of very large flight nets strung between two poles. These poles were sometimes over 200 metres apart and were permanently located on flight lines much used by waterfowl on their way from the foreshore to their feeding areas. Channels and creeks were favourite sites. The Katzie, for instance, had family-owned poles at Widgeon Creek and at the mouth of another creek at the southeastern end of Pitt Lake. The net of sinew and gut was usually suspended from ropes of cedar fibre that were passed through bone rings at the top of the poles. A man hidden at the base of each pole could then quickly drop the net when the birds swept into it. This was especially necessary to prevent damage to the nets by heavy birds in sites like Chemainus Flats on Vancouver Island, which at that time were said to be much frequented by geese and swans. Smaller birds such as ducks sometimes fell to the ground after impact or, if they became entangled, were killed with arrows. Paul Kane saw such nets in use as late as 1859 on the Washington shores of the Juan de Fuca Strait. He stated that the net was stretched across a narrow valley to catch ducks as they flew in from the sea, and added that ". . . a smokey fire is made at the bottom of the net which prevents the ducks from seeing it, and when they fly against it they become confused and fall down" (Kane, 1967).

Earlier, Captain George Vancouver saw such poles on Puget Sound and Strait of Georgia, when, much to the wonder of the Coast Salish, he arrived in tall white ships to survey the shores. He noted a detailed description, including the rings of blackened stones between the poles, but he failed to guess their purpose because he sailed into these waters in May, when most of the waterfowl had departed northward and the Indian fowlers had taken down their nets and turned to fishing (Meany, 1957; Pearse, 1968).

The lives of the Stalo and their coastal neighbours were governed by the migratory movements of fish and birds and by the ripening of the bog fruits. Theirs was a year of inevitable returnings, as certain as the rising and setting of the sun or the cycle of the seasons. Their calendar began with the coming of the Sockeye Salmon, their second month was marked by the arrival of the Dog Salmon or Chum. Next was the month of gathering berries, crabapples and wapato or "duck potato", and of meat hunting as the wapiti and coast black-tailed deer came down from the mountainsides and the wildfowl returned to the marshes. The fourth and fifth months were the time for netting ducks and harpooning sturgeon near the villages. The long wooden houses were filled with the harvests of the seasons, so these months were also

the time for the spirit dances that took place during the long nights of winter. The skins of waterfowl were used to make ceremonial capes and ornamental caps and duck and goose down was woven into the blankets that were often given as gifts (Binns, 1953; Drucker, 1963). Now the men hunted and fished close by in order to take part in the dances. For some it was an opportunity to express in dance and song the guardianship of the spirit that gave them their life-long skills. Most dances were over with the month of the Sandhill Cranes, when great lines of these birds came down out of the sky into the berry bogs and filled the valley with the sound of their trumpeting. Geese and ducks were again numerous and netting was resumed. Sturgeon were also more plentiful, as were trout, and there was ample food for the spring feasts, for storing was no longer necessary. Then the fowl were gone and the eulachon were raked and scooped from the river's shoals. Most of a month was devoted to the capture of this little "candle-fish" for its precious oil. The spring salmon also arrived and the new year began when the height of summer had passed and the sockeye faithfully re-appeared, transformed again from the Salmon People who lived far to the west in the halls beneath the ocean. They were welcomed with the

"first salmon" ceremony expressing gratitude and veneration for the immortal beings reincarnated from the bones and skins cast into the waters and returning to be food once again for the People of the River (Jenness, 1955).

The bounty of the months, seasons, and years was re-affirmed by all the sights and sounds of the delta; by the cry of the Snow Geese carried on the west wind to the villages above the tide, by the blood-red gleam lent to the streams by the throng of sockeye eager to spawn. For it had ever been so. The fish had re-appeared at the beaches, the seal swam into the narrow waters, the fowl had come back to the marsh; all that died and went with the river into the ocean beneath the setting sun, returned. Life on the river had acquired a pattern for the Stalo, a cycle of certainty built up over 10,000 years. It was shattered and ruined within a century, for, though the strange men in the tall white ships had sailed away, others were soon to return and put an end to the "dream time" of the Stalo Prole.

6. The Coming of the White Men

. . . investigate the whole of the Natural History of the countries you are to visit. At each place where you land you are to inform yourself as well as you are able what sort of Beasts, Birds, and Fishes likely to prove useful for Food or Commerce, are to be found and pay particular attention to various ways of catching them in traps or otherwise used by the natives . . .

Instructions given to Archibald Menzies, Surgeon and Naturalist on Captain Vancouver's Voyage of Exploration, 1792-3.

Theed Pearse, 1968.

Many reports of early explorers mentioned large numbers of waterfowl and shorebirds on the coasts of Puget Sound and the Strait of Georgia. Captain George Vancouver noted that

> ". . . on our first arrival, the aquatic birds were so numerous that we expected a profuse supply of wild fowl; but these were all so extremely shy and watchful, that our guns seldom reached them; and on being fired at, they disappeared" (Meany, 1957; Pearse, 1968).

But this was a minor disappointment compared with Vancouver's failure to locate the mouth of the Fraser, or the Rio Blanca as it was then called on Juan de Fuca's chart. Paradoxically Simon Fraser, who did

find it in 1808, was also disappointed; he was hoping to arrive at the mouth of the Columbia River. To make matters worse, Fraser and his men hazarded the wild and terrifying journey down the canyon and reached the mouth of the river, only to be driven upstream by a volley of arrows from the suspicious Musqueam Indians. It would be an understatement to say that Simon Fraser had neither the time nor the inclination to observe the bird life of the delta.

The men of James McMillan's expedition who set out in the wet winter of 1824 to investigate Fraser's river, were not in much better spirits, but one of them, John Work, kept a journal in which he recorded that they saw a herd of wapiti near the junction of a small tributary, the Salmon, and the Fraser River. A Mr. McKay shot one. Later Work noted that "On the low land at the entrance of the river, geese, particularly white ones, were very numerous and were by no means shy, they allowed themselves to be approached easily. Mr. McKay killed 3 of them" (Work, 1824).

When James McMillan returned in the 72-ton schooner *Cadboro* two and a half years later, it took him nine days to find the channel through the sand banks and marshes that had hidden the mouth of the Fraser from Captain Vancouver and his crew. McMillan selected a site for a fortified depot near the mouth of the Salmon River where he had first set eyes on the Fraser. For almost ten years the danger of raids by the dreaded Yeukeltas, the southernmost band of the Kwakiutl, kept the white men close to Fort Langley, but after the defeat of a war party in 1837, settlement began to extend across the valley.

These first settlers were trappers; men like Sam Hall, who built a cabin in 1845 where beaver and mink were numerous on the shore of the Campbell River which flows into Semiahmoo Bay. Today all but a very few of the lakes, ponds and beaver pools of the Fraser Valley have gone, leaving no trace. But in Sam Hall's time, every depression in the landscape was waterlogged, and most streams were dammed by the beaver. For about 30 years, Sam Hall and a few other white trappers shared with the Indians the wildlife paradise which was the Fraser Valley. But the steel traps they used, like Mr. McKay's gun, were a testimony of the arrival of the Industrial Revolution. As the efficiency of the traps reduced the beaver, the trappers moved on. Sam Hall is remembered only because the site of his home is called Hall's Prairie to this day (Treleaven, 1969). [See also Gibson (1976,P.4) who states that fur-bearing mammals were "virtually eliminated" within a generation after the founding of Fort Langley.] But he left a process of change behind him. Many of the beaver dams were rotting and collapsing. The waters flowed faster from the hills into the valleys, causing greater fluctuations in the levels of the smaller rivers and eventually flooding the flat lands of the alluvial plains. Alders, willows and poplars grew unchecked over the ponds and swamps, swallowing up the habitat of

Mallard, teal, Wood Duck and the Hooded Merganser. The process of environmental change induced by man began in a small and subtle way, but it continued unceasingly.

The successive waves of trappers, farmers, loggers, engineers and developers have so profoundly altered the appearance of the Fraser Valley that it is only by a real effort of imagination that we can regain a picture of what it was like a century ago. A few places along the delta foreshore, on the smaller river islands or in the peat bogs of the valley bottom, still retain some of the characteristics of the landscapes of the past. Further south, in the valleys of the Skagit, Nisqually and Snohomish Rivers, the seeker who is willing to leave the motor roads will find further lingering evidence of the sort of wild lands that confronted the pioneers. When we consider the hard and challenging lives those people must have lived it is not difficult to understand why they lacked the time, the knowledge or the wish to record the natural history of the wilderness tamed by their daily efforts. However, some written records have survived in the notes of the surveyors who prepared the valley land for subdivision in 1859 and 1873 (North and Teversham, 1976). Also of particular interest to naturalists are the memoirs of John Keast Lord (Lord, 1866).

Educated at the Royal Veterinary College in London, Lord had much of that enthusiasm for combining science and adventure which carried so many young Victorians around the world. After serving with Britain's Turkish allies in the Crimean War, he was sent to British Columbia in 1858 as veterinary surgeon and naturalist on the British North American Boundary Commission. He was an avid collector and he returned to England with a large array of specimens for the British Museum. In 1866 he published a book in two volumes entitled *The Naturalist in Vancouver Island and British Columbia*. It is a rich but poorly

organized assortment of observations and anecdotes of the curiosities of the natural and native life of British Columbia and the Pacific Northwest. The second volume contains an appendix listing the mammals, birds, reptiles, insects, fishes and shell-fishes he encountered or collected on his travels. His writings have historical as well as zoological value, especially if read in conjunction with the diary of Lieutenant Charles Wilson, secretary of the commission, who for several periods during their work on the boundary was Lord's closest companion (Stanley, 1970).

Both men were impressed by the number and variety of the waterfowl they observed in Victoria. In the first week of October 1858 Wilson recorded that ". . . ducks of numberless varieties, with geese, cranes, etc. are arriving in myriads, so numerous indeed that when they are disturbed on the harbour, the flapping of wings can be heard a couple of miles off." He and Lord were eager to see the marshes of the Fraser River, and their opportunity came when they were ordered to take provisions and mules to the base camp which had been established at Sumas Prairie. On October 13, they steamed through the islands on the Hudson's Bay Company ship *Otter*, and arrived at Nanaimo where Lord shot a ". . . fine specimen of a Snow Goose." He remarked that the ". . . Indians kill large numbers of them, and for the table they certainly excel any of the other species." Not everyone would agree with his taste in goose flesh, nor with his harsh opinion of the chowder made from the local clams which he called ". . . the vilest concoction" he had ever tasted.

Lord described the eight-inch "Great Clam" or horse clam as "a sort of mulluscous cereal" to the Indians, and depicted "an army of squaws" levering them out of the mud with bent sticks. While on the subject of clams, he happily digressed to relate an old fowler's story of how he was able to bag a Mallard with the butt of his gun because a clam was holding it fast by the beak.

On leaving Nanaimo, Lord and Wilson crossing the Strait of Georgia, observing ". . . a few whales spouting in our passage . . . (and) anchored at six inside the much dreaded bar of the Fraser River." At daybreak on October 15, they continued their journey. Lord observed ". . . very large flocks" of medium-sized Canada Geese feeding ". . . at the entrance to the Fraser River". He identified them as "Hutchin's Geese, *Bernicla Hutchinsii*, Bonap", a name that remained unchanged until 1929 when Taverner renamed the western, middle-sized birds Lesser Canada Geese. Today most authorities recognize the smaller, darker form found in the most westerly part of their breeding range as yet another subspecies, Taverner's Canada Goose (Taverner, 1931). Lord described these geese as "very abundant" and they probably out-numbered the Snow Goose which he styled as "common".

Among the other species listed by Lord as occurring at the mouth of the Fraser River was the California Condor. As he also included the Turkey Vulture there is no question of confusion with that bird. Twenty-two years later John Fannin saw two California Condors in Burrard Inlet. The occasional presence of this huge raptor is, perhaps, not surprising because its breeding range once extended as far north as the lower Columbia River, and it was probably drawn to the lower Fraser by the masses of dead and dying salmon, just as Turkey Vultures and Bald Eagles are today.

Beyond the delta, Lord and Wilson journeyed up the ". . . magnificent river, thickly wooded to the very banks with maple, fir, etc." They arrived at Fort Langley in the pouring rain, but a break in the clouds opposite the fort enabled them to see ". . . beautiful hills covered with snow . . . said to abound in mountain sheep." Their informant was probably referring not to sheep but to mountain goats, a few of which still survive on the high slopes of the Coast Mountains above the Fraser River. For four wet, boring days Lord, Wilson and their men huddled in the crowded cabin at the fort while an attempt was made to repair the engine of the stern-wheeler *Maria*, which was to take them up to Sumas Lake. Finally, they decided to leave five men with the mules and push on in an open boat. "Even in the wet we could not help admiring the beauty of the river," wrote Wilson in his diary. "The foliage was at its best, the bright red of the dogwood, the yellow of the maple and dark cedars and pines, made a gorgeous scene." Around their camp they found tracks of deer, otter and mink and "the cackling of geese and ducks was incessant."

Two days later, after the arrival of the *Maria*, Lord and Wilson, in a light canoe, led the party for about five miles up the Sumas River, ". . . a beautiful stream crowded with wild duck." But their hopes of some shooting were frustrated by the incessant rain which made it impossible to keep the percussion nipples of their guns dry. By noon they found themselves stuck fast in Sumas Lake, "which was so shallow in some places that even canoes could not get nearer in shore". There was nothing for it but to wade for about two kilometres to the lake edge and then carry the stores a further six kilometres through "a marshy prairie, the grass of which reached the shoulders of the men." They arrived at the base camp after dark, too exhausted even to eat.

The return journey a few days later was made in better spirits. Wilson recorded that ". . . as the weather was only showery we had some good shooting, indeed we filled the canoe with birds, principally stock ducks (Mallard), teal, herons, godwits and moor hens (Coots)". They also saw "numbers of geese" but could not delay to stalk them.

Having spent 17 days in sodden clothes, Lord and Wilson were glad to get back to Esquimalt. They passed the rest of the winter there with entertainments and field sports. "We get plenty of duck shooting

now the cold weather has commenced," Wilson noted. "Pintail and Ruffle head (*sic*) are very pretty and there is a great variety of them."

In the spring the Boundary Commission established its headquarters and depot at Chilukweyuk (Chilliwack) Prairie, which Wilson regarded as the most beautiful place he had ever seen, ". . . covered with flowers and strawberries, . . . waving grass and belts of poplar, willow, ash and maple in the foreground, . . . a view of the Fraser Valley for about 60 miles with snow-capped mountains on either side . . . there are plenty of bear and deer about us here." Lord was even more impressed by the nearby Sumas Prairie which was particularly rich in wildlife, so he set up a temporary camp there. He described it as follows:

> "In May and June this prairie is completely covered with water. The Sumas River from the rapid rise of the Fraser, reverses its course, and flows back into the lake instead of out of it. The lake fills, overflows and completely floods the lower lands. On the subsidence of the waters we pitched our tents on the edge of a lovely stream. Wildfowl were in abundance; the streams were alive with fish, . . . we were in second Eden!"

Unfortunately the idyl was soon shattered, for after Lord had enjoyed a week at his delightful camp ". . . the mosquitoes began to get rather troublesome." Within a few days they increased beyond all belief into "a thick fog." The mules were driven wild, dogs buried themselves, and six of the horses had to be turned loose to fend for themselves, their skins a mass of sores. The canvas of the tent was almost hidden under a coat of the insects. The men could not stand being

eaten alive; work became "utterly impossible," and by the end of July the camps on the prairie were abandoned and the commission retreated to the mountains.

As the swarms of insects grew in number, Lord observed that ". . . birds of various species arrive to devour them, build their nests and rear their young." The most numerous were "White-bellied Swallows" (probably Tree Swallows), flycatchers, "sedgebirds" (warblers) and a host of other migrants which he listed in an appendix to his book. Among the more conspicuous birds on Sumas Lake were the Sandhill Crane, Great Blue Heron, American Bittern, Osprey and Bald Eagle. Later in the year Lord was annoyed by the "disagreeably bold" behaviour of the eagles, when they frequently pounced on the Mallards brought down by his gun, even before the smoke had cleared away. Sometimes he gave the robber ". . . the benefit of a second barrel, as punishment for his thievery."

The sportsman could well have forgiven the eagles the theft of a few ducks, for by October the valley was filled with hosts of migrating waterfowl ranging from teal to swans. Lord saw Trumpeter Swans on the Fraser and Columbia rivers only occasionally. He obtained a specimen at Fort Rupert, and noted that the Indians brought their skins into the Hudson's Bay Company trading posts where they were prized for their down. But he described Whistling Swans as "common" in the valley, when they appeared with their brown-plumaged young in the fall. Lord saw them in October on Sumas Lake where they fed with the flocks of White-fronted and "Hutchin's" Geese that gathered there during their migration from the Arctic.

Although the White-fronted Goose is now regarded as a rare winter visitor in the Fraser Valley, Lord ". . . noticed this singular goose to be much more abundant on the west than the eastern side of the Cascades." He watched "immense flocks" arrive on the Sumas and Chilukweyuk prairies. The White-fronts were always accompanied by equally impressive flocks of "Hutchin's Geese" (Taverner's Canada Geese) which were "very abundant east and west of the Cascades and on Vancouver Island". In September and October large flocks fed ". . . on the Sumas and Chilukweyuk prairies." Both the "Hutchin's" and White-fronted Geese flew further south when winter closed in, but in March they returned again. A year later Lord found that the "Hutchin's" Goose was ". . . also very plentiful in the Colville Valley (eastern Washington) during the spring and fall." He saw it in Oregon too, probably in the Klamath Basin which he crossed in 1860 on his way back from San Francisco where he had been buying mules. Today the Columbia Basin and the Willamette Valley, Lower Klamath and Tule Lake refuges provide the major wintering areas for Taverner's Canada Geese.

The larger Canada Geese, which Lord observed as "common east and west of the Cascade Mountains; seldom seen but in pairs," were probably the Great Basin Canada Geese, which still nest on islands in the Columbia River in southeastern Washington. Lord was unaware that Canada Geese would breed in the arid, high country south of Colville and was most surprised when one of the geese he shot on the way to Walla Walla contained a fully developed egg. It is no longer possible to say with certainty whether the Canada Geese observed by Lord west of the Cascades were the *moffitti* or the subspecies known as the Vancouver Canada Goose *B.C. fulva* that now breeds along the coast and islands of British Columbia and southern Alaska. Like those east of the Cascades, they were usually seen in pairs, but the habitat available to nesting geese in the Fraser Valley would have been more suited to *fulva*, which has adapted to the fringes of wooded or bushy terrain, and to the variable levels of mountain runoff and tidal waters.

Although Lord appears to have spent much of his time shooting ducks, he made little mention of their habits or distribution in his book. In the appendix he described the Mallard, Pintail and Green-winged and Blue-winged Teal as "common both on the coast and on the lakes and rivers inland." The remaining 21 species on his list of dabbling and diving ducks were merely described as "regular visitors."

The Fraser Valley as depicted by Lord in his book was still a wilderness, but even as he watched its wildlife and compiled his notes, events were taking place which would tame the landscape within a few decades. The work of the British North American Boundary Commission was made urgent by the Fraser River Gold Rush in 1858, which by the year's end had brought 25,000 prospectors and adventurers up the coast from California. Food supplies for this invasion were limited because the only farm was operated at Fort Langley to grow vegetables for trade with the Russians in Alaska. The prospectors paid $90 for a single sack of potatoes and $8 for a dozen eggs. Governor James Douglas hastily issued regulations for the pre-emption of land. For eight shillings, or about a dollar, a settler could obtain 160 acres (64 hectares). Along the banks of the Fraser and the shores of its delta, the grasslands were walled in by dykes and the sediments of centuries were turned by the plough. In the three years after the building of the first dyke in 1861, 14,000 farm animals were driven into the Fraser Valley from the Oregon Territory to the south. By 1863 there were over 250 farms along the Fraser River and between 1861 and 1871 the white population rose from 300 to 1,292. In the same decade the Stalo people were reduced by smallpox from 60,000 to 30,000 (Siemens, 1968; Winter, 1968).

The ecological changes were enormous. When all the grasslands had been enclosed by the dykes of the first settlers, the next wave cleared the "hardhack" and bush. New grasses and clovers were intro-

duced and, with them, new weeds. Behind split-cedar and, later, barbed-wire fences, grazing cattle changed the plant ecology of the meadows. The dykes built around the farms to keep out the high tides, and the summer freshets, held in the rains of winter. On Boundary Bay, the future Premier, John Oliver, saw in a "revelation from God" how to build a tidal sluice box with a flap lid on a pipe which was pushed shut by the high tide but opened at the ebb to let the rain water flow out. But in 1894 the flood plain was returned with a vengeance to the river. First, the Fraser froze so hard that horse-drawn sleighs could be driven from the North Arm of the Fraser to Langley. Bitter cold and deep snow lasted well into the spring. Then a sudden spell of hot weather came in May bringing the "Great Flood". The brown water raged over the land from Matsqui and Mission to Ladner on the delta, and the dykes crumbled and collapsed like sand castles before the tide (Hutchinson, 1950). When the flood receded the settlers resolved to build a system of dykes, not around each farm, but along the entire delta coast and the tidal reaches of the Fraser, Nicomekl and Serpentine Rivers. It was an enormous undertaking. The completion of 530 kilometres of dykes brought about the most profound environmental change in the history of the Lower Mainland. Much of the salt marshes and most of the brackish and fresh-water marshes and swamps of the lower Fraser were now wrested from the river (Winter, 1968). They were converted into an orderly landscape of fields, meadows and woodlots, inhabited not only by the human community of settlers but also by other aliens that thrived in such a landscape, the Norway rat, the eastern cottontail, the opossum, the Ring-necked Pheasant and the Starling (Carl and Guiguet, 1957–72).

The ecological systems of the wetlands were relegated to the surviving remnants of wilderness left in the bogs, in the narrow strip of tidal marsh beyond the dykes and in a few areas of swamp bypassed and left to the river. One of these areas, a great flat half-moon shaped expanse of marsh, bog and swamp on the south bank of the Fraser near its confluence with the Pitt River, remained a wilderness for decades. But finally, in the early 1970s, bulldozers began to push a layer of sand and sawdust three metres thick over the rich life of Surrey Bend, the last of the lower Fraser's fresh-water marshes.

At the turn of the century a far larger marsh still survived, blocking the very centre of the valley, Lord's "second Eden", Sumas Lake. In 1878 proposals had been made to drain the lake, but pumping began in 1923 after almost half a century of legal and financial haggling. Within a year 8,000 hectares of peripheral marshland were cleared and sown, and by the second summer 3,600 hectares of lake-bottom land were also exposed for the plough (Siemens, 1968).

As the water table of the valley dropped the peat bogs and swamps began to disappear under thickets of birch, alder and willow. Along the rivers the ancient stands of spruce, cedar, fir and poplar were felled by the farmers for lumber and firewood. As the bottom land was filled with homesteaders, new settlers began to cut and burn clearings in the forests. Endless stands of mighty trees seemed to mock the puny efforts of man. But within four decades, they were all gone; felled by the axes and saws of the loggers, carried off to the rivers on a network of rail lines and swallowed up by the smoking mills along the shores.

So, within a century all was changed. The great marshy wilderness of river, estuary and coast and its flanking forests were conquered. The Stalo had become the Fraser, and the Stalo Prole were a forgotten people living on the fringe of a landscape that they could no longer recognize, and beside a culture that they could not understand. The salmon still came, though the numbers of the sockeye were sadly depleted. But the swans had left the marshes, the geese no longer returned to the prairies, and the voices of the cranes were seldom heard trumpeting the coming of spring across the berry bogs.

7. The Decline of the Waterfowl

Swans frequent the lakes, and innumerable quantities of geese are ushered in with winter, among which may be enumerated the Snow geese, the White-fronted goose, the Brant goose and the Canada goose; the latter often reaches 17 pounds in weight.

Mathew MacFie, 1865

. . . geese are far too intelligent to suffer endless persecution simply in order to live in an otherwise suitable locality. Constant bombardment will eventually drive them away, unless they have some place to go where they know they are safe . . .

Michael Bratby, 1939

Although descriptions of the wildlife in the lower Fraser Valley prior to the 1920s are rare and sparse, they are consistent in showing that White-fronted Geese, Taverner's Canada Geese, Great Basin Canada Geese, Brant and Whistling Swans were more abundant as transients or winter visitors than they are today. Lord's observations of waterfowl were used by John Fannin, the curator of the Provincial Museum in Victoria, in the *Check List of British Columbia Birds*, published in 1891. In 1904 Fannin's list was updated by his successor, Francis

Kermode, who had the benefit of the observations and collections of specimens made by the naturalist and bird painter Allan Brooks (Fannin, 1891; Kermode, 1904).

Brooks made important contributions to our knowledge of the birds of the Fraser Valley at the turn of the century. He arrived in Chilliwack in 1887 when he was 18 and "chuck full of enthusiasm for ornithology." In a period of 11 years he shot and trapped specimens of 253 species of birds and of about 60 mammals in the same Chilukweyuk Prairie beside Sumas Lake where, a few decades earlier, Lord had established his camp. As a result, this region was in his words, ". . . more thoroughly worked ornithologically than any other portion of the Province." It was also significant that during the decade of his residence in Chilliwack Brooks observed considerable changes in the bird life there and commented on them in his published notes and letters, especially in "Birds of the Chilliwack District, B.C.", in the *Auk* January 1917, and in *A Distributional List of Birds of British Columbia* that he compiled in collaboration with Harry S. Swarth for the Cooper Ornithological Club, Berkeley, California, in 1925. In the following year he was both illustrator and "a constant source of inspiration and information" to P. A. Taverner in producing his *Birds of Western Canada* (Brooks, 1917; Brooks and Swarth, 1925; Taverner, 1926; Laing, 1979; Leach, 1981).

During the 1920s and 1930s Martin W. Holdom, R. A. Cumming and other devoted observers in the increasing number of naturalists' clubs in the Fraser Valley added their annual notes to the growing knowledge of the distribution and migratory habits of the birds of British Columbia.* But for the larger water birds of the lower Fraser Valley, this collection of knowledge came too late. By 1947, when J. A. Munro and Ian McTaggart Cowan published *A Review of the Bird Fauna of British Columbia*, the Whistling Swan, the Great Basin and Taverner's Canada Geese, the White-fronted Goose, and the Brant, all formerly abundant on the Fraser River, had become rarities or transients no longer remaining in their former haunts (Munroe and Cowan, 1947).

The previous chapter outlined the drastic and rapid environmental changes that took place in the lower Fraser Valley after the Gold Rush of 1858. However, it would be an over-simplification to accept the decline of the geese and swans in the region as an inevitable con-

* The Rev. Martin Holdom's contributions to ornithological journals are listed in the bibliography in Munro and Cowan, 1947. He also wrote a regular column in the *Chilliwack Progress* and the *Surrey Leader*, selections from which were published in Holdom, 1952, 1953 and 1955. In 1937 he began the Annual Christmas Bird Count at Crescent Beach and published the results in *The Canadian Field-Naturalist*. Later this was extended to White Rock, South Surrey and Langley. Its results are published, together with those of the Vancouver Christmas Count, in *American Birds*. See also Cumming, 1932.

sequence of the conversion of most of the Fraser River's flood plain and delta into agricultural and urban-industrial land. Before white colonization the quantity of habitat available to waterfowl was subject to severe natural limits. Some aspects of agricultural development have, in fact, increased habitat suitable for certain species of wintering waterfowl, especially White-fronted Geese, Canada Geese and American Wigeon which prefer to graze on wet grasslands.

As described earlier, the parts of the delta and flood plain providing the best natural habitat for waterfowl were those in which regular flooding ensured the survival of aquatic food plants or fostered the predominance of short-stemmed fine grasses. These comprised the comparatively narrow zones between the lines of low tide, normal high tide and storm high tide, plus those areas upstream from the tidal reaches that were subjected to regular flooding by seasonal rains or by the freshets of melt-water from the mountain snowfields. The saline foreshore marshes provided habitat for Brant and the brackish estuarine marshes met the needs of Lesser Snow Geese, but grazing geese were mainly dependent for their food on the prairies at Sumas Lake, and on the "wet grass prairies" and "red top grass prairies" of the delta, recently mapped from the surveyor's notes of 1858 and 1873 by Margaret North and Janet Taversham of the Geography Department of the University of British Columbia. Both the White-fronted Goose and Taverner's Canada Goose have comparatively short bills adapted for grazing grass of moderate length. The observations of Lord and Brooks confirm that the main feeding areas of these birds were on ". . . the grassy and swampy ground at the entrance to the Fraser River and on the Sumas and Chilukweyuk Prairies" (Lord, 1866; Brooks, 1917; Brooks, 1918, 1925; North and Taversham, 1976).

These grasslands were, however, of comparatively limited extent in relation to the valley as a whole. On one side they were contained by the tidal or river waters and on the other by extensive bogs, swamps, scrub and forest, from which plant life continuously invaded and colonized the prairies as they were raised in elevation by sedimentation and by their own plant growth. Indeed, the isolation of Sumas Prairie within the great expanse of forests was reflected in its very name Sumas which is derived from the Indian words *se math*, meaning "big opening" (Matsqui-Sumas-Abbotsford Centennial Society, 1958).

Not all open uplands were grassy. Extensive bogs occupied much unforested terrain in Delta, in the central and eastern parts of Lulu Island, in South Burnaby, in the lowlands between the Serpentine and Nicomekl Rivers, and west of Fort Langley, in the central and southern parts of the Pitt Valley, in Surrey Bend, and in Sumas Prairie. In recent years Taverner's Canada Geese have been observed foraging for berries in the bogs remaining in Delta and Lulu Island and a former market hunter reported that "Honkers" used to fly into Burns Bog for berries

70 or 80 years ago (verbal accounts to the author by James Murray in 1964 and by Harry Weaver in 1975). Such areas were much more open than they are today because the Indians burnt them to foster the growth of berries. But the bogs were at best only secondary sources of food for waterfowl.

Marshes and wetter grasslands around shallow lakes are habitats most favoured by Whistling Swans. They often graze, but usually prefer to grub for food in the mud of very wet locations and are far more dependent upon aquatic plants than are the grazing geese. Early reports confirm the preference of swans for such habitats in the marshes of Sumas Lake and the Pitt River (Lord, 1866; Brooks, 1917; Suttles, 1955).

When the white settlers began to pre-empt land, prairies and wet grasslands were their first choice of location. Major farming settlements were established between 1862 and 1866 on nearly 36,000 hectares of land along the Harrison and Chilliwack Rivers and in Sumas Prairie. The conversion of large areas of coarse wild grass, shrub and bush into fields of meadow, root crops, and grain, especially oat hay, must have provided a major addition to the feeding areas available to the geese which congregated on Sumas Lake. Meanwhile, on the outer delta the settlers located dykes along the beach ridges and natural levees of the rivers. As a result, comparatively little loss was inflicted on the plant communities of the foreshore: the eel-grass community of Boundary Bay, and the bulrush and cat-tail communities of the estuarine banks and islands. In contrast the landward wet grass and redtop grass communities were almost entirely enclosed by dykes. However, these changes alone do not explain the decline of the field-feeding geese. In spite of the dykes and drainage ditches, the heavy winter rains continued to cause puddling and sometimes extensive

flooding in the grasslands. Then the clearing of shrubs, scrub-trees and woodland from the swampy lowlands in the following decades resulted in more large areas of cattle-grazed pasture and arable land subject to puddling and flooding. Thus the feeding habitat suitable for grazing geese in winter was greatly increasing at the time of their decline (Winter, 1968; North and Taversham, 1976).

The draining of hundreds of sloughs, ponds and small lakes, which also took place at this time, undoubtedly contributed to changes in the habits and distribution of ducks and swans, but it did not affect the geese which use this type of habitat much less. The biggest drainage projects, including the construction of the unified system of dykes following the 1894 flood, the draining of Sumas Lake between 1920 and 1924, and the draining of Pitt Polder in the late 1940s, all took place after the decline of the grazing geese and the Whistling Swan in the lower Fraser Valley.

It is also significant that a temporary decline of the Lesser Snow Goose and the loss of the wintering flocks of Brant both occurred in spite of their main feeding habitat on the tidal foreshores remaining largely intact. Thus we can conclude that while habitat changes undoubtedly affected many wildlife species, they were not the sole cause of the decline of the large waterfowl.

Environmental changes have taken place in Europe as a result of the clearance of forests, the draining of marshes and fens, and the enclosure of common land. The increase in meadow and arable land, together with the greater nutritive value of grassland resulting from agricultural improvements, has led to shifts in the distribution of grazing geese and to an overall increase in their wintering populations (Owen, 1976; Reed, 1976). The conversion of the landscape there took place over centuries; in the Fraser Valley it has occurred within a few decades, but the change in the valley from wild grasses in wetlands to agricultural grasses in dyked meadows cannot in itself explain the disappearance of the geese. What seems more important is that the change occurred under conditions which gave little opportunity or encouragement for the birds to adjust because they were subjected to a marked increase in disturbance by people. At the same time larger, more attractive winter habitat was made available further south, first by extensive irrigation schemes and later by wildlife refuges in Washington, Oregon, and California. (Butcher, 1963; Chapman, Henny and Wright, 1969; Institute of Environmental Studies, 1980).

Wild geese and swans are creatures of habit. Within their annual cycle of migrations between their breeding habitat and their wintering habitat, they follow a daily cycle of feeding, taking grit, preening and loafing. All of these essential daily actions are governed by a need for security. Thus geese select winter habitat which avails food in an open,

wet landscape, within a fairly short flying distance of suitable roosting and loafing areas on coastal flats, isolated lake shores or river sandbars. If such habitats are changed the birds will vacate the area. Similarly, disturbance which interrupts the daily cycle, especially on the crucial feeding grounds, will cause their departure. If the disturbance is persistent, the departure will be permanent, especially if alternative areas are available.

Wild animals, including even the most wary, do not regard all human activities as a disturbance. Routine operations, such as farming, soon become recognized and accepted by geese, especially when conducted by people whose attention is perceptibly not directed towards them. But geese react very quickly to actions which are clearly a threat, and once they have been subjected to shooting, they will seldom linger to determine whether the humans observing or approaching them are motivated by curiosity or by predatory intentions. In view of the nature of the human community in the Fraser Valley in the nineteenth century, it is certain that by far the greatest disturbance suffered by the geese, swans and cranes was the result of hunting.

O Wattlekainum, chief of the Kwantlen,
Where are they gone?

Where are the swimmers in streams of bright water?
Lost in the halls of the sea-deep beyond?
Where the grey buglers haunting the berry bogs?
Where the great goose skeins and where the white swan?
Weaving with wings the skies of new valleys,
Preening their plumage on far distant shores?

Lost to the nets and the spears of the Stalo,
Gone from the swamp and the marsh evermore.
Only returning in fires at the evening,
Lighting the lodges with flickering flame,
Moving with memories the minds of the Old Men,
Inwardly burning with sadness and shame.

B.L.

PART TWO:
THE WATERFOWL

They are mysterious birds coming from far-away northern lands, impelled by an unknown force and kept infallibly on their course by an unknown sense. They are wild and wary birds, a traditional quarry of man from immemorial times. Their flight is swift and their formations fill the sky . . .

Peter Scott, 1939

8. The Swans' Exodus and Return

Nothing can be more splendid than the flight of a flock of wild swans, as they pass over your head with their transparently white pinions, and uttering their far-sounding and musical trumpeting, which is often heard before the birds come into sight.

Charles St. John, 1844

Swans are the largest and most majestic of the waterfowl. When they are dispersed in their summer habitat across the tundra and the open grasslands, the advantage of concealment is outweighed by their need for communication, so they are plumed to be conspicuous. Their bugling voices also reach far across the wide expanses they inhabit. The length of their necks and bodies enables them to feed on aquatic vegetation below the reach of surface-feeding ducks, and, like ducks, they tip up to extend their reach in deeper waters. Their bills are adapted to their mode of feeding, the mandibles having fairly sharp edges, serrated, and tipped with strong nails. The tongue, also rough and serrated, combines with the bill to provide an efficient means of grasping, tearing and chopping. Small food particles floating to the surface are picked up by "dabbling", the process of passing water quickly between the mandibles and the tongue, while using the serrations as a sieve. While feeding, swans paddle their powerful feet to wash mud from the roots of plants, and to stir up food from the bottom. Each day an adult swan consumes about 20 pounds of vegetation (Boyd, 1972; Owen and Kear, 1972).

The head of a feeding swan is dipped under water for about 20 seconds. When raising it to breathe the bird looks for danger. Some observers have reported that while a flock is feeding one bird acts as sentry with its head raised on watch and prods another to take over this responsibility before beginning to feed itself. However, it seems unlikely that there is any system of guarding. Older adults tend to be more wary, and may give the impression of acting in rotation when they push aside their nearest neighbour upon resuming feeding. Swans also feed on land where they graze grasses like geese, or eat waste grains and unharvested root crops. In wet, puddled meadows they also pull up vegetation, but in British Columbia their numbers are no longer great enough to make them a serious agricultural problem.

For thousands of years man has had an ambivalent relationship to swans. They have been a source of legend, an inspiration for art, and a quarry for the chase. The quotation at the beginning of this chapter was written after a long description of a hunt in which the writer endured hours of cold and discomfort to "take his satisfaction of the swans" by shooting two of them on a Scottish Loch. He then went on to lament the "constant warfare" declared against them (St. John, 1844–1919).

In North America the shooting of swans was conducted on a commercial scale in the nineteenth century. Each bird yielded between one and two pounds of down, a score of quill pens, and several pounds

of meat. The Trumpeter Swan suffered the worst, and its former breeding range, extending south to Iowa and Missouri and east to Indiana, was drastically reduced to a few isolated areas in the west. Between 1823 and 1880 the Hudson's Bay Company sold some 108,000 swans' skins in London (Hewitt, 1921; Hochbaum, 1955; Banko and McKay, 1964; Hansen *et al.*, 1971; Bellrose, 1976; Palmer, 1976). By 1916, when legal protection was given to the swans, less than a hundred Trumpeters were believed to survive. However, during the 1960s three or four thousand of the swans nesting in Alaska, formerly thought to be Whistling Swans, were identified as Trumpeters. The process of destruction has now been reversed and the Trumpeter Swan is the subject of a vigorous campaign of protection and propagation. Birds have been transferred to refuges in Oregon, Nevada, South Dakota, Wyoming, Washington, Manitoba and British Columbia. The population is now over 5,000 birds.

The Trumpeter Swan was not subjected to heavy exploitation in British Columbia because its nesting and wintering sites were unknown. Many probably remain so. Most of the 4,000 Trumpeters nesting in Alaska are believed to move down the coast into British Columbia and winter in scattered flocks among the inlets and islands where they are probably joined by swans from breeding areas in this province. Recent counts in the sheltered estuaries of Vancouver Island have shown a remarkable increase to over a thousand Trumpeters. Some Trumpeters winter in Puget Sound, in Grays Harbour, along the lower Columbia River, and on Clear Lake near Mount Vernon, Washington (Palmer, 1976; Bellrose, 1976). They occur as rare transients in the lower Fraser Valley, but in the winter of 1977-78 no less than 87 remained for several weeks in the Pitt Valley and a year later over a hundred were seen at the same location. Increasing numbers also visit Nicomen Slough near Deroche.

Past records indicate that the Trumpeter Swan was usually a rare visitor to the delta. In 1866 Lord recorded that he saw the Trumpeter only occasionally on the Fraser and Columbia Rivers and not nearly as often as the Whistling Swan. During over a decade of collecting at Sumas Lake, Brooks shot only one, and in 1925 he described it as "scarce and irregular" there. Subsequent reports confirm that its visits to the Fraser and Pitt Valleys were also irregular. A pair lingered at Reifel Island for several weeks in March 1969, apparently attracted by the pinioned Trumpeters in the sanctuary (Lord, 1866; Brooks 1917; Brooks and Swarth, 1925; Cumming, 1932; Leach, 1970; Rogers, 1971; Campbell, Shepard and Drent, 1972; Leach, 1972).

In 1965 a pair of Trumpeter Swans found in the Fraser Valley with gunshot wounds were treated on Burnaby Lake. Although it is most unusual for wounded birds to mate and nest, these did so the following spring. Unfortunately, their eggs were destroyed by boys with air

guns. In the following year the swans successfully hatched three cygnets but the entire family was killed a few weeks later by waste oil discharged into a creek flowing into the lake from a nearby maintenance yard for government vehicles.

Trumpeter Swans may often be mistaken for Whistling Swans. The Trumpeter is usually slightly larger, but small Trumpeters may be smaller than large specimens of Whistling Swans. The Trumpeter is usually silent, especially on the wintering ground, but when it does call its deep bugling honk is quite distinguishable from the more melodious, higher-pitched and quavering call of the Whistling Swan. The best field mark of the Trumpeter is the posture of its neck. When relaxed the first few vertebrae at the base are laid back to form an angle with the rest of the neck which is held upright. The Whistling Swan's neck is held directly upward from the front of the body. However, when alert or suspicious the Trumpeter also raises its entire neck into the upright position (Palmer, 1976).

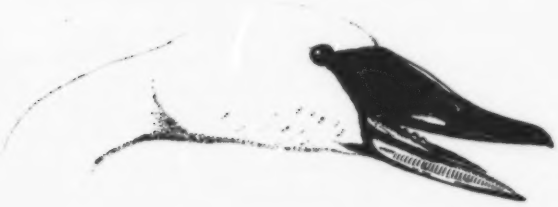
Whistling Swans breed on the Arctic slope and islands from Alaska to Baffin Land. Most of them undertake a vast migratory flight diagonally across the continent to winter on the Atlantic coast. However, about 15,000 fly to Malheur Lake and the Klamath Basin in Oregon and to the central valleys of California. A further 10,000 to 15,000 migrate from Alaska down the coast to Puget Sound, the lower Columbia River, and the bays of Oregon and California. A few of these birds visit the interior valleys of British Columbia, especially near Creston. Fewer still are seen on the coast or in the Fraser Valley.

Whistling Swans were probably more regular and numerous visitors along the Fraser a century ago. The Katzie Indians hunted them regularly in the Pitt River marshes, and in 1858 or 1859 Lord saw them on Sumas Lake in October, accompanied by brown-plumaged young. Brooks also saw them there in "large numbers" in the late fall, and found "they decoyed very readily to an imitation of their call." In November 1894 he saw "about a dozen large flocks" and was puzzled by the presence of an adult and two very dark juveniles of contrastingly smaller size. In their *Distributional List* of 1925, he and Swarth described the Whistling Swan as a "fairly common migrant, remaining all winter on the coast." In the early 1920s the Reverend Martin Holdom, vicar at Surrey Centre, met old settlers of his parish who recalled "that flocks of swans used to settle . . . on the marsh between the Nicomekl and Serpentine Rivers," but in 1932 Cumming listed the Whistling Swan as an "irregular winter visitor." By 1947 Munro and Cowan classed it as a transient on the coast and stated that "a flock of swans of this species, wintering on the South Thompson River . . . constitutes our only winter record of healthy birds. Winter-taken specimens from the coast examined in the flesh represented obviously sick birds, or birds which had been wounded earlier and thus prevented from migrating" (Lord,

1866; Brooks, 1917; Brooks, 1918; Brooks and Swarth, 1925; Cumming, 1932; Munro and Cowan, 1947; Holdom, 1951; Suttles, 1955). Since then the Whistling Swan has appeared more frequently on the delta, sometimes in flocks of two or three dozen birds. In 1965 larger numbers arrived in the Nicomekl-Serpentine Valley east of Mud Bay where over a score were illegally shot. Seventeen wounded survivors were treated and nursed back to health in Stanley Park. Most of them were released on Beaver Lake. Flocks of both Whistling and Trumpeter Swans also visit the marshes and fields near the mouth of Canoe Pass west of Ladner. Here, too, there were victims of illegal hunting and, in 1981, nine were shot from a flock attempting to winter at Brunswick Point. (Rodgers, 1971; Campbell, Shepard and Drent, 1972; Leach, 1972).

Occasionally Whistling Swans are attracted by the pinioned swans in Stanley Park; one observer, L. K. Wade, described their arrival as follows:

> "This was a day in October when the air was crisp and the sky a startling blue . . . Because it was Sunday, there were many people walking around the park . . . Then the swans came in. There were four—the cob and pen . . . and two tan-coloured cygnets . . . it was probably the high-pitched "whistling" notes that first attracted the people's attention to the huge birds overhead. The four swans made one wide sweep over Lost Lagoon, the adults brilliant white against the sky, and after circling once, came down . . . straight across the middle of the lagoon. Of all the people that were there that day, there were none whose attention was not focussed on these birds. Few people had been paying particular attention to the captive Mute Swans, but these wild birds, sweeping across the lagoon, had brought with them a feeling of the wilderness—and of freedom—that no-one could miss" (Wade, 1972).



9. Goose From Beyond the North Wind

For years I have considered the snow geese to be one of the great wildlife spectacles in Canada's southwest, yet they do remain outside most people's first-hand experience. They stay rather far off-shore, loafing and feeding out there, and when they fly they are white and numerous and beautiful, but still remote.

R. Yorke Edwards, 1971

The wild spirit of the Fraser Delta is embodied in the Snow Geese. Their plumage matches the snow-capped peaks that provide the background to the landscape of grey waters and muddy tide-lines where they spend their winters. The eye of the watcher is drawn seaward by their babbling chorus. Their far-flying lines weave across the skies of dawn and dusk until lost to sight in the haze below the mountains.

Snow Geese are best viewed at a distance. At close range they appear clumsier than other geese. Their necks are short and thick and their wings are blunter and less graceful than those of other waterfowl. They are grubby feeders, poking their strong bills into the mud of the outer tidal marshes to tear up the roots of the bulrushes which flourish there. Often their heads are completely immersed; as a result, they are stained a rusty brown colour because many of the marshes where they feed have ferrous organic compounds in the soil. The corner of their bills is permanently set in an inane grin which, together with their dirty faces, gives them the ludicrous appearance of a small boy caught at the treacle jar.

Here the Snow Geese are in fact seldom guilty of "raiding the larder" for they do little damage to crops in the Fraser Valley. They rarely leave the delta marshes, and when not feeding they fly out into the strait and rest in large "rafts" on the open water or on the sandbanks at low tide. Sometimes, in stormy weather, snow or fog, they cross the dyke and settle inland, but this is unusual.

Before the dykes made a clear delineation between the land and the tidal marshes, Snow Geese occasionally wandered further up the Fraser River than they do today. Brooks stated that ". . . a small flock was always present on the prairie (at Sumas)" in the spring of 1896 but it was "rather rare" to see them so far from the estuary.

Old hunters called the Snow Geese "wavies" because of the undulating lines they formed across the sky, and remembered the days when they were regularly shot in the fields of Delta. But by the 1930s hunting had made them wary and even the grain stubbles on Westham Island failed to draw them in. In 1930 R. A. Cumming noted that the flock at the mouth of the Fraser had ". . . greatly diminished in recent years." During the hunting season they shunned the marshes by day and came in to feed only at night. The Annual Report of the British Columbia Provincial Game Commission for 1951 described how the Snow Geese became ". . . almost non-existent when their (hunting) season opened." The game warden from Ladner scanned the coast looking for them and finally discovered 40,000 ". . . wintering a few miles from Boundary Bay in the State of Washington" where the hunting season on them was closed (Cumming, 1932; British Columbia, 1951–56). Early in the 1960s the flocks from the Fraser shifted still further south and joined those wintering on the Skagit Delta, where the shooting of Snow Geese was limited to half a dozen enthusiasts. Since the establishment of the sanctuary at Reifel Island several thousand geese remain throughout the winter on Roberts Bank.

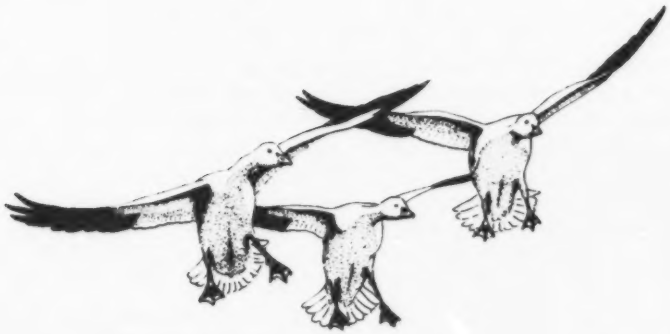
The scientific name of the Lesser Snow Goose recognized by the American Ornithologists' Union is *Chen caerulescens hyperborea*. At one time it was considered a full species and known as *Chen hyperborea* or "goose from beyond the north wind", a title both romantic and apt because this bird nests on the Arctic tundra. For many years it was assumed that the geese on the Fraser Delta came from Arctic Canada and, possibly, Alaska. But early in the 1960s hunters began to find bands which had been placed on the legs of Snow Geese by Soviet scientists on Wrangel Island off the northeastern coast of Siberia.

The Snow Geese on this large uninhabited island are the last survivors of the birds which once had a breeding range extending eastward from the lower Ob River across the continental tundra of Siberia and several large Arctic islands. The geese then wintered on the shores of the Caspian Sea and in Japan—where they were abundant,

and in North America (Uspenskii, 1965; Edwards, 1971; Burton, 1973). The Soviet explanation of their decline and disappearance from the Siberian mainland over the last 150 years is that they were annihilated on their wintering grounds, ". . . especially in the Far West, on the North American prairies, which were extensively colonized by European emigrants in the middle of the last century." Another contributory factor according to Dr. S. M. Uspenskii, ". . . was obviously the changes in the terrain caused by ploughing the prairies" (Uspenskii, 1965; see also Palmer, 1976). The deduction which attributes the disappearance of a Siberian breeding population, formerly wintering on the Caspian and in Japan, mainly to unbridled hunting in North America is to say the least astonishing.

Fortunately, the Russians set up a wildlife sanctuary on Wrangel Island in 1960 to protect the estimated 200,000 occupied nests of the geese against the further taking of eggs and other forms of human exploitation. At first there was an improvement in their numbers and some spreading of these birds to other islands and to the mainland. Attempts were also made by Dr. Uspenskii to re-establish breeding populations with geese reared in captivity.

The clutch of between four and six eggs is laid in a nest that is little more than a scrape in the moss or gravel of the tundra lined with a few twigs, grass, and some down. The nests are quite conspicuous, and many eggs and young are still lost on Wrangel Island to Arctic foxes. The geese defend themselves by nesting in colonies. Nests on the edges of colonies suffer the most damage, while those in the centre of



the colonies have few losses. Some Snow Geese nest in small groups, with Brant and eider, near the nests of Snowy Owls. According to the Russians, the owls put up such a vigorous defence of their nests that they afford protection to all the nests of other species in the vicinity. American scientists are inclined to be skeptical about the importance of the owls' protection to the survival of small colonies. Again, one is tempted to see political overtones.

The worst threat to nesting Snow Geese is a deterioration in the Arctic climate which has caused snow to persist on the nesting areas after the return of the geese. Uspenskii recorded delayed starts through late springs in 1958 and 1964, and in 1965 there was an almost complete failure to nest due to snow on Wrangel Island. On the Pacific Flyway that fall only five per cent were juveniles, but 1966 brought a recovery with 59 per cent observed as young of the year. The early 1970s were again bad years for reproduction and the Russians reported that the number nesting in Siberia fell to 60,000 pairs. The cold weather of 1972 was particularly disastrous because it affected not only the Wrangel Island population, but also those in the high Arctic of Canada and Greenland. Flooding on the nesting sites, and freezing rain which killed many goslings, extended the disaster to 1974. In the winter of that year the flocks of Snow Geese on the Fraser Delta were almost entirely composed of adult birds. These geese suffer an annual loss of about 30 per cent of the population, mostly to hunting. This had led to the conclusion, recently expressed in the *Handbook of North American Birds*, that ". . . on the average, an individual survives to breed successfully only once." As a result the Lesser Snow Goose population can vary considerably from year to year (Palmer, 1976; Bellrose, 1976).

Wrangel Island is not the only source of Lesser Snow Geese on the Pacific Flyway. There are also scattered colonies on the Arctic coast of Alaska, and a few Snow Geese nest on the Bering Sea coast; perhaps as a result of old or weakened birds dropping out of the migratory flight to Wrangel Island. There are also isolated nesting populations on the Mackenzie and Anderson River Deltas and on Banks Island. Most of the western breeding birds migrate to California.

East of the Mackenzie Delta there are large breeding colonies scattered right across the high Arctic to the northwest coast of Greenland. Other colonies have developed dramatically on the shores of Hudson Bay and James Bay during the last three decades. The Snow Geese nesting east of Perry River, which include an increasing number of the dark-plumaged "Blue Geese", winter mainly on the coast of Texas and Louisiana, but some of the most northeasterly populations from Greenland and Ellesmere Island fly to the Atlantic coast of the United States. The Greater Snow Geese also winter on the eastern seaboard. Some of the Lesser Snow Geese from the central and eastern Canadian Arctic winter in Mexico. The average winter population in

North America is over one and a half million birds (Palmer, 1976; Bellrose, 1976).

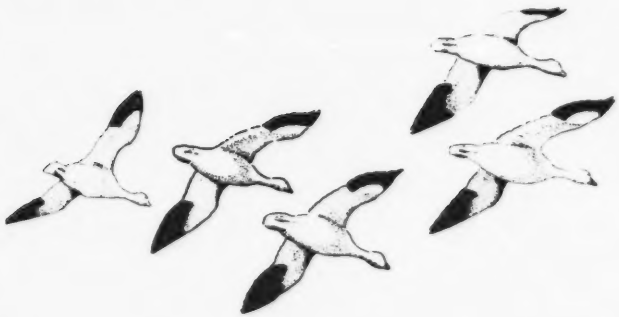
The great majority of the Lesser Snow Geese wintering on the Fraser and Skagit Deltas seem to be birds from Wrangel Island, perhaps with a few from Alaska. After leaving their summer range they rest on the Stikine Delta which, by coincidence, is near Wrangel, Alaska, and reach their wintering habitat on Sturgeon and Roberts Banks and the Skagit Flats early in October. The recovery of Russian bands from Snow Geese in the refuges in Oregon and northern California indicates that many of the Siberian geese pass through Klamath and Tule Lake and winter in the Sacramento Valley. Some of these birds use the deltas of the Fraser and the Skagit Rivers as staging areas, especially on the return journey to their nesting grounds. However, most geese in the Siberian and west-Alaskan populations, totalling over half a million, by-pass these small deltas, flying down the outer coast in the fall and through the interior as far east as Montana in the spring. The flocks counted on the Fraser do not usually exceed 10,000 birds, even in the spring when they reach their peak numbers. Eighty kilometres further south, on the Skagit, they total between 15,000 and 20,000 geese. On both deltas numbers drop sharply through late December, January and February, especially in cold winters (Edwards, 1971).

It is possible that part of the Siberian population migrates across Alaska; some birds may go so far east that they join with part of the Banksian population and migrate up the Mackenzie Valley to the extensive staging areas on Great Slave Lake, Hay Lakes and in southern Alberta.

The importance of staging areas for these long-distance travellers cannot be overstressed, and it seems likely that the Fraser and Skagit estuaries are of more importance to the Snow Geese in this role than as wintering habitat. Staging areas are particularly important in the spring because they provide an opportunity for migrating birds not only to rest, but also to feed and thus build up stores of energy required to sustain them on the nesting grounds, where initially food is scarce. Mating activity also takes place on staging areas so that the eggs are forming as the geese fly north. They start laying between two and seven days after their arrival in the Arctic in the last week of May (Uspenskii, 1965; Burton, 1973).

Adverse winds or bad weather may cause delays on the way so the first eggs may be dropped before the arrival. Inadequate food prior to the flight north may also have adverse effects, birds not in peak physical condition laying infertile or fewer eggs, or dropping them without nesting. Arctic birds have no time for a second nesting attempt. If anything goes wrong with their first clutch they spend the rest of the summer with other non-breeding birds on the fringe of the nesting area or in the moulting habitat.

Russian, American, and Canadian biologists put together the facts about the life cycle of the Snow Geese of Wrangel Island only in the last two decades. Their work came just in time to confirm the importance of the Fraser Delta to these geese, and to hundreds of thousands of other waterfowl and shorebirds which nest in the Arctic regions of Asia and North America. The breeding success of all such birds depends partly upon the quantity and quality of foods they obtain in their wintering areas and along their migration routes. Every piece of tidal foreshore marsh destroyed by human development means a further reduction in the world's population of migratory birds. With such concerns in mind a small group of conservationists, hunters, naturalists and biologists came together in December 1960 to begin the discussions and plans that resulted in the establishment of the sanctuary on Reifel Island for the Lesser Snow Geese, and for the other waterfowl of the Fraser Delta.



10. Canada Geese in Several Sizes

A little farther on he found a group of people whose faces were streaked with charcoal. They too (like the Sandhill Crane sisters) had refused to follow Swaneset to Katzie, but roamed the fields, homeless, and passed the days in play. After their play they retreated to the ponds and sucked the roots of the grass that grew around the edge. Khaals said to them: 'Is that how you spend your days?'

'Yes', they answered laughing.

'Very well. Now you shall fly, . . . You shall be geese,' Khaals called, 'and those who shall come hereafter shall feed on you.'

The Katzie Book of Genesis
Diamond Jenness, 1955

October is a rich month in the Clover Valley. The evening sky is full of sound and movement. The gulls winging seaward take on a golden sheen from the low sun's rays shining through the gap between the clouds and the Gulf Islands. Even after a dull day the whole valley is illuminated by the brilliance before sunset. Half an hour later, silhouetted against the more subdued colours of the dusk, flights of Green-winged Teal, Mallard and Pintail rise from Mud Bay and fly between the estuaries of the Nicomekl and Serpentine Rivers up the valley

where remnants of the summer's crops lie in the fields. At dawn they will again fly to the sand bars of the twin estuaries to sleep and preen.

Watching these daily movements develops in the observer an awareness of the patterns of change on the delta: the daily and seasonal movements of the sun, the monthly cycles of moon and tide, shifts in wind and weather. Perception of such things gives rural life its richness of contact with the natural world. The city dweller shuts himself off from these elements. If he sees the sky he seldom perceives its messages. But he has not quite lost the urge to stop and look when he hears the cry of wild geese flying south.

Most migrating Canada Geese crossing the Fraser Valley in October are probably Taverner's Canada Geese. They come down the valleys of the Coast Mountains and over the waters of Pitt Lake, Indian Arm or Howe Sound in skeins of up to 500 birds and pass over the delta farmlands about a thousand metres high without pause or hesitation. Only a few stragglers descend into the tidal marshes or meadows. Most head on to the river bars and grainfields of the Columbia Basin. Yet not long ago this goose was the commonest of all the geese in the lower Fraser Valley.

When John Keast Lord observed ". . . very large flocks" of "Hutchin's Geese" on the Fraser Delta and Sumas Prairie, he recognized them as migrants from the Arctic arriving in September and October in large numbers and concentrating again on the Fraser marshes in March before proceeding north to nest. In 1917 Allan Brooks in his *Birds of Chilliwack District* re-affirmed Lord's account and described these geese as having been "common and at times very abundant." But he reported that flocks that used to remain on Sumas Lake and Prairie every fall and spring "mostly pass over now." However, he added that ". . . a few remain with the 'Honkers' all winter and one or two can usually be found throughout the summer, but of course do not breed." A year later Brooks commented in the *Canadian Field–Naturalist* that the Hutchin's Canada Goose was still ". . . the commonest goose in B.C.," but most flights of this species ". . . pass through between 1st October and 25th November and again from 10th April to 20th May." In 1925 he and Swarth described it as ". . . a common migrant, a number remaining throughout the winter on the southwestern coast" (Lord, 1866; Brooks, 1917; Brooks, 1918; Brooks and Swarth, 1925).

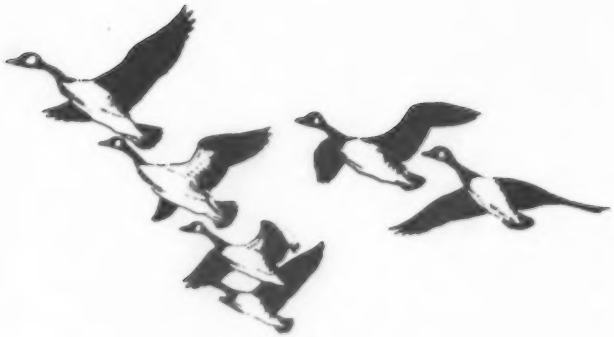
In the course of their co-operation both Brooks and Taverner had noticed considerable differences between the middle-sized geese of the east and those of the west and, in 1929, Taverner divided the former Hutchin's Canada Goose into two subspecies and gave them both new names, the eastern race becoming Richardson's Canada Goose and the western race the Lesser Canada Goose. More recently the darker, slightly smaller birds, nesting in the interior of Alaska and wintering

on the Pacific Flyway, were recognized as a separate race and named Taverner's Canada Goose in honour of the Canadian ornithologist. But by then the medium-sized geese were abandoning their traditional British Columbian wintering grounds. In 1947 Munro and Cowan in their *Review of Bird Fauna of British Columbia* referred to the Lesser Canada Goose as "a transient" and stated that they had been ". . . unable to substantiate the statement (by Brooks and Swarth) that a number winter on the southern part of the coast" (Brooks, 1926; Taverner, 1931; Munro and Cowan, 1947; Scott, 1957).

Since then Taverner's or Lesser Canada Geese have made several attempts to re-establish themselves as winter visitors in the lower Fraser Valley. They were particularly encouraged in the early 1960s when Bruce McLean, a man with a great love of animals and of the land, dammed a stream on his beautiful 200-acre farm in Langley. This formed a small lake that seemed an ideal place for waterfowl, so he released a few pinioned Canada Geese and Mallards there. To protect them he closed his farm to shooting.

Then the wild geese arrived. At first only a dozen flew down to the meadow by the lake. Each year more came, until in 1963 almost 2,000 Taverner's Canada Geese spent the daylight hours feeding in the meadows and bathing and preening on the lake, or down in the marshes of the Campbell River that crossed the farm. Every evening they flew back to their roost near the junction of the Nicomekl and Serpentine River estuaries in Mud Bay.

The presence of the geese added to the quality of hunting of the shores of Mud Bay, but for some hunters this was not enough. They followed the geese to their feeding grounds, ignored the No Hunting signs posted round the farm, shot at the geese and drove them away. Disillusioned by his bitter experiences, Bruce McLean sold his farm. Fortunately it is now part of a regional park. But the geese have not returned, and for almost a decade the Taverner's Canada Geese seldom stopped in the Fraser Valley. Since the introduction of feral Canada Geese, small flocks of Taverner's Canada Geese have been decoyed by them into various parts of the Fraser Valley especially at the Reifel Migratory Bird Refuge in Delta and at Serpentine Fen in Surrey. These medium-sized geese are fairly easy to distinguish. Their call has a higher pitch than that of the 'Honker', their wingbeats are more rapid and they have a shorter-necked appearance in flight which makes their wings appear longer in proportion to their bodies. In company with the local geese their smaller size and darker plumage marks them out. Some have a white collar at the base of the black neck plumage. Above all they are wary. Until the end of the moratorium on Canada Goose hunting in 1978 the feral birds flew into their feeding areas low and without much hesitation. In contrast, the wild geese flew high and circled six or seven times before alighting. Once they had landed, they



did not immediately commence feeding, but stood, with necks fully extended, alert and suspicious, scanning their surroundings for possible dangers.

Their caution is understandable. Their arrival in October coincides with the opening of the hunting season. Seen through the eyes of an approaching goose, the Fraser Valley offers few undisturbed areas for feeding or loafing. The areas closed to hunting are mainly so designated due to their high density of human activities so they hold little attraction for geese. Fields in the sanctuaries at Reifel Island and Serpentine Fen are too hemmed in by hedges or dykes to attract large flocks of these wary birds. Only a very small part of the foreshore marshes is closed to hunting so a secure roost is hard to find. Prior to the hunting season and during the night large groups sometimes come down to preen and rest on the tidal sands in Mud Bay or Semiahmoo Bay. Early in October 1963 over 2,000 Taverner's Canada Geese flew into Mud Bay and remained there from mid-afternoon until sometime during the night. In mid-October 1976 a very large flock landed in Semiahmoo Bay at White Rock at about 1 a.m. At dawn they rose with a great clamour, circled the bay and resumed their flight southward.

The repeated visits of these geese suggests that, given sufficient undisturbed habitat for feeding and loafing, they might return regularly in numbers to the lower Fraser or Pitt Valleys. In spite of attractive winter habitat available in the grainfields of central Washington and in the National Wildlife Refuges of Oregon and California, some are still drawn to the coastal deltas. A few have even wintered as far north as Prince William Sound in Alaska.

Unlike the Taverner's Canada Goose, the tiny Cackling Canada Goose has never been numerous on the Fraser delta, but it occurs regularly in very small numbers. This goose is conspicuously small when seen with other Canada Geese. About the size of a Mallard, it weighs only about 2 kilograms. It has dark plumage, the underparts of some individuals are quite sooty and its bill is very stubby compared with that of the larger varieties. Until he shot a specimen, Brooks confused it with "Hutchin's Goose". Now it is recognized as a transient visitor. One or two occur each year, usually in the fall or spring in locations where there are other geese: Reifel Island, Serpentine Fen, Stanley Park and Burnaby Lake. The main migration corridor of Cackling Canada Geese extends from their breeding grounds on the west coast of Alaska southeastwards across the open sea to the mouth of the Columbia River. From there they fly inland to the Klamath Basin where they remain to rest and feed before flying on to their principal wintering areas in the Central Valley of California. Since the migratory movement of "Cacklers" bypasses the Fraser delta their arrival here is accidental (Palmer, 1976; Bellrose, 1976).

The Aleutian Canada Goose, another very small subspecies, once nested on several of the Aleutian Islands. The introduction of Arctic foxes for fur farming eliminated the geese on all except Buldir Island where about 200 breeding pairs survived. This bird is now listed as "endangered" and the United States Fish and Wildlife Service has undertaken a program to foster its revival. Habitat improvements and the reduction of foxes have been followed by the release of captive-bred stock on islands formerly inhabited by them. Studies were also made of the migratory movements of Aleutian Canada Geese but, at first, they were seldom reported because few observers could identify them in the field. These geese have a ring of white feathers at the base of the black "neck-stocking", but this is not a reliable characteristic because it varies in size and some Cackling Geese have it too. In order to aid identification over a hundred Aleutian Canada Geese were caught on Buldir during their moult and fitted with blue and green leg bands. The sightings and recoveries of banded birds in California resulted in the closing of all Canada Goose hunting in three northwestern coastal counties and in parts of the Sacramento and San Joachim Valleys. Although hunters and naturalists in other parts of the Pacific Flyway are requested to look out for Aleutian Canada Geese, none has yet been reported in British Columbia, so it seems that, like the Cackling Goose, this subspecies flies off-shore, down the outer coast, so rarely visits this province (Byrd and Springer, 1976; Rhode, 1977).

Probably a light form of large Canada Goose regularly visited the Fraser Valley in the past, and a dark form was an occasional visitor. Fannin stated in 1891 that the Canada Goose was a "very abundant resident (that) breeds throughout the interior of the Mainland, appears

in great flocks along the lower Fraser River during the winter months, and affords fine sport for the gunners." Both he and Kermode clearly separated this bird in their lists from the smaller "Hutchin's Goose" or "crow goose" of the lower Fraser, from the "White-cheeked Goose" (the Dusky Canada Goose), and from the Cackling Goose. Specimens of the last two were reported shot by Allan Brooks at Chilliwack (Fannin, 1891; Kermode, 1904; Brooks, 1917).

When he published his list in 1917, Brooks was still sorting out the subspecies of Canada Geese, but he made it quite clear that both light and dark forms of "Honkers" were present. Of the Canada Goose he wrote:

> Common: remains throughout the coldest winters and a few can be seen on Sumas Prairie all summer, but do not breed. I think it breeds at Chilliweyuk Lake at the head of Chilliweyuk . . . River. In the winter and early spring are seen the dark form of this species. At first I took these for *occidentalis* (called the White-cheeked Goose by Fannin and Kermode) but the size and measurements of those shot were fully up to the maximum of *canadensis*. Several times I have had flocks of the light and the dark "Honkers" feeding just out of gunshot of me and keeping apart from each other (Brooks, 1917).

The light "Honkers" seen by Brooks were probably Great Basin Canada Geese that migrated to the coast from their breeding areas in the interior valleys of British Columbia.

The present status of the Great Basin Canada Goose is difficult to establish now that so many feral Canada Geese are seen in the valley. During the 1950s and 1960s "Honkers" appeared during September and October in the Pitt Marshes, and were presumed to be geese that had migrated from the interior. At the same time a small flock of light "Honkers" was seen regularly in late August and September in the Mud Bay area. These birds appeared to be wild, but it is also possible that they wandered from Stanley Park (pers. obs.).

It is not known if this subspecies ever nested in the lower Fraser Valley. Unlike the Sandhill Crane, which was a familiar neighbour of the Indians along the river, the Canada Goose received little mention in the folklore of the Stalo people. Allan Brooks never substantiated his suspicion that it might breed at Chilliwack Lake. If any subspecies of Canada Goose once nested on the lower mainland coast it was more likely to have been the Vancouver Canada Goose which now breeds on the Queen Charlotte Islands and on the mainland coast of southern Alaska and British Columbia. The large, dark geese observed by Brooks with the "Honkers" at Sumas Lake could have been these. He noted that: "The underparts of the dark form are often as dark as the upper surface and abruptly defined against the white of the ventral region," and correctly suggested: "This is probably the breeding bird of the coast strip to the northward." But it is doubtful that he was as correct

in detecting a difference between these dark birds and the "decidedly smaller" specimens from Prince William Sound, Alaska. Later, the population breeding on coastal areas in Northern Alaska was named the Dusky Canada Goose. This subspecies may also have occurred more frequently on the lower Fraser in the past though it is seldom reported here today.*

Both the Vancouver and Dusky Canada Geese have very dark chocolate brown plumage and are about the size of the Great Basin Canada Goose. However, they are so similar in appearance that several authorities do not recognize them as separate subspecies. Nevertheless, the two populations differ in their migratory behaviour. While the southern population is fairly sedentary, wintering on the coastal inlets, the Dusky form, breeding in Alaska, 300 miles further north, migrates down the Pacific Coast to stop-over places on the Queen Charlotte Islands and on Vancouver Island, then on to the Columbia River Delta, and up the Columbia and Willamette Rivers to their main winter range in Oregon. There, three comparatively small National Wildlife Refuges, totalling 4,245 hectares, in the farmlands of the Willamette Valley have provided a secure wintering base for this subspecies of Canada Goose. The success of these refuges demonstrates what could still be done for the Canada Geese in the Fraser Valley if suitable

* Pearse (1968, p.255) notes the Vancouver Canada Goose could have been resident at the southern end of Vancouver Island in 1791.

portions of Crown Lands on the delta and in the Pitt Valley were similarly managed (Chapman, Henny and Wright, 1964; Pacific Flyway Council, 1973; Palmer, 1976).

In summary, the wild Canada Geese that may be seen in the Fraser Valley are:

Taverner's Canada Goose—medium-sized, darkish plumage, formerly the most numerous of this species, still pass over on migration in large skeins, some occasionally come down in quiet open areas;

Great Basin Canada Goose—large, light plumage, formerly very numerous, status now impossible to judge due to the presence of feral Canada Geese also of light plumage;

Dusky Canada Goose and Vancouver Canada Goose—large, dark chocolate-brown plumage, indistinguishable from one another in the field, rare transients;

Cackling Canada Goose—smallest subspecies, a rare transient (Scott, 1957).

11. Goose of the Pacific Coast

. . . particular communities of birds use special migratory routes.
. . . the persistent persecution of that community on that special route will eventually exterminate that community.

R. Meinertzhagen, 1935

Brant are small geese that spend most of their lives on the seashore. They are usually seen as a distant line of darkly plumaged birds feeding or loafing on the mud flats at ebb tide or sitting offshore on the water. In flight their short necks and rapid wing beats give them the appearance of a sea-duck to the casual observer. They are usually shy and avoid the land, flying swiftly and low over the water in trailing lines or packs that bunch and extend on the move in an ever changing pattern. In good light their white sterns, typical of all geese, are especially noticeable in contrast to the rest of their plumage. They have a throaty growling or croaking call that is audible over long distances. When the shooting season ends they lose some shyness and may be seen at Beach Grove, Crescent Beach and White Rock quite close to the shore, seeking eel-grass, their principal item of diet.

In 1891 the Brant was described in the *Check List of British Columbia Birds* as: "abundant winter resident." Wintering Brant remained plentiful on the coasts of Vancouver Island and Boundary Bay until well into the twentieth century. Harry Weaver, a former market hunter, recalled, in 1975, that when he began fowling in 1895 at the age of 14, the shores of Mud Bay and Boundary Bay were at times "solid with flocks of Black

Brant." They came in so continuously to decoys that on one occasion he and eight other hunters took turns shooting from a single blind and picked up 128 birds in the course of a few hours. Market hunters on Vancouver Island and the Lower Mainland were especially busy in December shooting large numbers of Brant for sale at Christmas, when they fetched 50 cents a brace. A market hunter named Franklin shipped two sacks of Brant on the twice-weekly boat to Victoria and others to Vancouver. In one good year he and a companion sold 2,500 Brant to Pat Burns and Company before New Year's Day! (Fannin, 1891; Weaver, 1975; Munro, 1977).

During these years of plenty it was not unusual to find a few Atlantic, or light-bellied, Brant among the flocks on the coast of Vancouver Island. Allan Brooks shot eight of these birds in Comox Harbour on the 13th of December, 1903, and observed ". . . a number of small bands." He estimated that about eight per cent of the Brant in Comox Bay were of this subspecies. In 1934 several Atlantic Brant were shot further up the coast, near Campbell River. This subspecies nests in the central Arctic islands of Canada and occasionally breeds with Black Brant or joins their migration to the Pacific (Brooks, 1904; Einarsen, 1965).

In 1925 Brooks and Swarth noted that while the Brant was still a common winter visitant to the coast, ". . . in former years (it was) more generally distributed than at present." One report describes the wintering population in the 1930s as fluctuating between 1,000 and 5,000 birds in Mud Bay and Boundary Bay. In 1947 Munro and Cowan still listed it as a winter visitant but observed that it was ". . . much more abundant as a spring transient," and while the numbers reported in March were in the thousands, only a few hundred were observed in December. In the 1960s the wintering population dwindled to two or three dozen birds in Boundary Bay. A few birds are still seen irregularly in Semiahmoo and Boundary Bays in midwinter, probably wanderers from the flock which still winters in Padilla Bay, Washington. Christmas Bird Counts on Semiahmoo and Mud Bays reported 33 Brant in 1972, and none since. A report on the status of birds in the Vancouver area in 1970 produced by the staff of the Vertebrate Museum at the University of British Columbia placed the sad epithet, "rare winter," beside the name Black Brant (Brooks and Swarth, 1925; Cottam *et al.*, 1944; Munro and Cowan, 1947; Erskine, 1970; Campbell, Shepard and Drent, 1972; National Audubon Society, 1973; Munro, 1977).

Unfortunately, recognition of the decline of wintering Brant was overlooked by many observers because each spring large numbers of migrating Brant continued to stop and feed on the eel-grass beds in Semiahmoo and Boundary Bays. These are mostly birds which nest on the Yukon-Kuskokwim delta on the Alaskan Arctic coast, and on the Mackenzie River delta. In the late summer and fall they fly around the

Alaskan coast and congregate in large numbers at Izembek Bay on the Alaskan panhandle. Then, in the third week of October, all but a few take off, rise to over a thousand metres and fly directly to Baja California, where they winter. In February relatively small flocks of mated breeding birds begin to shift northwards along the coast, concentrating on favourable bays where eel-grass thrives from California to British Columbia. Between April and June they arrive back at Izembek Bay and after a period of rest and intensive feeding they move on and disperse to their nesting sites (Einarsen, 1965; Palmer, 1976; Bellrose, 1976).

In 1958, Charles Guiguet stated that a "few small flocks" winter on the Queen Charlotte Islands, along the inside passage, at Boundary Bay, and at various places on the coast of Washington. Recently the marking of Brant nesting on Canadian Arctic islands that formed the Banksian refugium in the last glacial period has confirmed that these birds are a separate population from the larger one which flies directly to California and Mexico from Izembek Bay. On the most westerly islands, Melville, Prince Patrick and Eglinton, 1,513 Brant were banded and 557 collared. By March 1977, 190 birds had been recovered and a further 87 sighted. Of these, 176 (92.6 per cent) of the recoveries and 59 (almost 68 per cent) of the sightings of these Canadan Arctic island birds have been made in Puget Sound, Washington (Munro, 1977). In addition, one collared Brant was seen in British Columbia, nine were recovered and seven seen in California, and two were recovered in Mexico. The remainder comprise sightings or recoveries in Russia, Iceland, and on the coast of western Europe, of birds which evidently migrate eastwards, together with the Brant nesting on the central and more easterly Canadian Arctic islands, Bathhurst and Axel Heiberg. Thus the majority of Brant from the westerly Arctic islands appear to winter on Puget Sound. A few wander south to California and Mexico where they intermingle with the Brant which fly directly there from

Izembek Bay. Nevertheless, the Canadian Arctic island birds seem to b[illegible] discrete breeding population which divides between two winter-in[illegible]reas, one on the European coast, and the other on a more northerly segment of the Pacific coast, separate from the main Brant wintering areas in California and Mexico. Normally the migration of geese nesting in the most northerly locations carries them south of the wintering areas of the geese nesting to south of them. But in this case the most northerly nesters are also the most northerly winterers. Some of these birds may migrate overland to the Pacific coast of British Columbia and Washington and bypass the staging area at Izembek. Reports from the Peace River in Alberta suggest that a few Brant migrate south by an overland route. A northward migration of this species via the Yukon Valley was reported as early as 1851 by Richardson (Guiguet, 1958; Palmer, 1976; Maltby, 1977; Munro, 1977).

It is logical to conclude that the Brant which once wintered on the coast of British Columbia were part of the Canadian Arctic island population, a remnant of which still returns annually to Puget Sound. Between 500–1,500 Brant also still winter at Sandspit and in Masset Inlet in the Queen Charlotte Islands, but the relationship between this population and those of Puget Sound or, formerly, of southern British Columbia, is not known (Munro, 1977).

The habitat of the Brant on the Fraser Delta is confined to the tidal flats especially along the low tide line where the eel-grass beds flourish. This plant provides most of its diet, together with some wigeon grass, sea lettuce and other algae. Very occasionally glasswort, sea blite and salt grasses may be nibbled by Brant loafing on the salt marshes during high tides or storms. A very small quantity of animal matter is eaten, much of it, such as fish eggs on the blades of eel-grass, by accident rather than intent. Thus, the winter status and distribution of the Brant depends mainly upon the availability of eel-grass.

Three other needs of Brant are grit, fresh water for drinking, and loafing areas for preening and resting. Beaches with suitable grit are located on the shores of Boundary and Semiahmoo Bays. Fresh water is readily available because three small rivers and several streams and drainage ditches discharge into the bays. Loafing areas are also found on the wide sand flats and, during storm tides, on a number of salt marshes and beaches.

As stated earlier, the pre-emption, dyking and draining of land for settlement on the Fraser Delta, had very little effect upon the outer tidal salt marshes and flats of Boundary, Mud and Semiahmoo Bays. The dykes were located along beach ridges and, where these were lacking, along the outer edges of the salt-marsh vegetation adjoining the land. Few areas containing eel-grass were enclosed by dykes.

Some habitat changes other than dyking have contributed to the depletion, or even to the eradication of eel-grass in certain specific areas. Harry Weaver remarked that there was once more eel-grass in Mud Bay than in recent years. If so, its decline there might be due to a combination of environmental changes. The construction of the dyke has not only reduced the size of Mud Bay but has also blocked off the tidal flow between the two estuaries and made the whole bay shallower. The sudden increases in the flow of fresh water down the Nicomekl and Serpentine Rivers after rainfall due to the clearing of the forest and the construction of upland drainage systems may also have affected the growth of the eel-grass, which needs salt water. Other adverse factors may include the drop in water quality due to the dyking, damming and polluting of the rivers, which have reduced oxygen levels, increased water temperature and added alien organic and chemical materials to the water. The flow, both of river and tidal waters, has also been changed by the dredging of a channel in the Nicomekl estuary to provide access for boats. Increased flow may have eroded or silted up eel-grass beds formerly present in the shoals at the mouth of the river. Nevertheless, such changes have not affected the main beds of eel-grass in Boundary and Semiahmoo Bays. In one location environmental change has even fostered the growth of eel-grass. Since the construction of the ferry terminal and superport on south Roberts Bank, eel-grass has increased in the tidal flat between the jetties, and Brant have been observed feeding there (Hoos and Hackman, 1974).

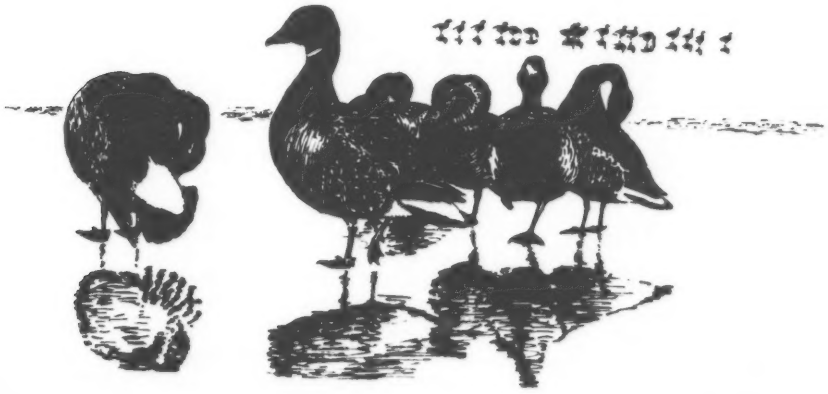
In view of the continued existence of large areas of eel-grass on the former feeding and loafing areas of the wintering flocks of Brant, there seems no justification for attributing their disappearance to the loss or serious depletion of their habitat. As in the case of the grazing geese, disturbance is the most likely cause of their departure from their wintering range on the south coasts of British Columbia (Munro, 1977).

In 1944, Cottam, Lynch and Nelson published a study of the Brant in which they recommended that "As a protective measure, rest areas should be established on the principal shooting areas." In his book *Black Brant, Sea Goose of the Pacific Coast*, published in 1965, Arthur S. Einarsen stated that "After a survey of the entire area that is used as a wintering ground by the Black Brant, it is becoming more and more obvious that human molestation is one of the major obstacles to their survival." A careful examination of various forms of disturbance led him to recommend restrictions on hunting which would reduce the degree of harassment; these included prohibition of blinds and scull-boats on the eel-grass beds and a limitation in the number of decoys permitted. But above all he stressed that "Brant without a refuge or sanctuary cannot continually face molestation on their feeding ground, despite earnest arguments to the contrary." He addressed his plea,

particularly to the naturalist-hunter to whom ". . . bag limits . . . are not nearly as important as skeins of Brant seasonally sliding across a sunset sky and their cheerful call drifting in over the waters." To such readers he sounded the warning that the major concern must be:

> . . . to insure the Black Brant enough sanctuary areas so their natural inclinations are satisfied; and to remember that the Brant as a species could be wiped out within a few years unless these desperate needs (food, grit and undisturbed loafing areas) are supplied (Einarsen, 1965).

On Boundary Bay the Brants' "desperate need" for grit brings them in to the spit at Beach Grove where a row of shooting blinds are permanently manned during the hunting season. In spite of the shooting, the Brant repeatedly return there and, according to a Vancouver sports columnist, some of the Brant kills there during the spring shooting season were ". . . little less than carnage." H. Albert Hochbaum, one of the best-known authorities on waterfowl in the world, visited the spit during the hunting season in 1969 and expressed grave concern at the killing of breeding pairs during the spring migration. Almost a decade later, Dr. G. V. T. Matthews, Director of Research of the Wildfowl Trust, was "staggered" to see that British Columbia still has a ten-day Brant season in March when ". . . more and more countries are giving up late winter/spring shooting." So, unfortunately, the Brants' "desperate needs" have been inadequately safeguarded both here and in the United States, and even as Einarsen was writing his words of warning the Brant were shifting from their traditional areas in southern British Columbia (Cramond, 1967; Hochbaum, 1978; Mathews, 1978).



A decade later the provincial Fish and Wildlife Branch recognized the loss of the wintering Brant and in the spring of 1977 issued a report attributing it ". . . primarily to hunting, firstly by gradually killing or harassing wintering birds and secondly, by systematically killing paired adult birds with a tendency to migrate early." Some hunters refuted this view and, according to a report in the *Vancouver Province* newspaper, they asserted that ". . . the high density subdivision of land and the all-winter pleasure boat interference was more likely to be the cause of diminishing numbers of winter birds." In fact, thanks largely to the work of the Save the Beaches Association in the 1960s, Boundary Bay has not been subjected to reclamation or development, so "high density subdivision" cannot be cited as a direct cause of disturbance on the Brant habitat in the municipality of Delta. However, "all winter pleasure boat interference" may have had some adverse direct and indirect effects upon the Brant. The location of marinas in the Nicomekl River estuary has caused a growing flow of boat traffic in the channel cut by the river across Boundary Bay. Some boaters may be observed deliberately chasing flocks of birds, but Oldsquaws and scoters, which sit out on deeper water, are usually the victims of such action, rather than Brant. Disturbance by boats going to the oyster beds in Mud Bay has stopped since the cannery at Blackie Spit closed in 1960 (Munro, 1978; Vancouver Province, 1977-78).

Furthermore, in March and April, after the hunting season, Brant may be seen very near boats in Drayton Harbour, Blaine, and in various locations close to human activity throughout Semiahmoo, Boundary and Mud Bays. This demonstrates that Brant are not normally disturbed by boating or by other human activities, unless they seem to be a direct threat to them. But the presence of hunters and their scull-boats or punts and blinds on Brant feeding or loafing areas is undoubtedly a serious disturbance to these birds and the one which must surely be the major cause for their abandonment of former habitats in British Columbia and elsewhere. No other factor appears to have directly affected their behaviour on a comparable scale. It is significant that wintering Brant populations subjected to less hunting, such as that in the Queen Charlotte Islands, have apparently remained relatively stable. Furthermore, Brant are now so sensitive to hunting, once they have experienced it, that they will be driven off by duck shooting taking place on their habitat even though they themselves are protected by closures (Ogilvie and Matthews, 1969; Harrison and Grant, 1976; Munro, 1977; Owens, 1977).

Unfortunately, in British Columbia, Brant hunting has not only scared the wintering birds off to quieter bays elsewhere, it may also have eliminated or seriously depleted discrete breeding populations which formerly wintered here. The seriousness of the situation was confirmed by checks of over 3,000 Brant shot in the last ten years on

Vancouver Island. These revealed that 96 per cent of these birds were adults. Provincial biologist William Munro has pointed out, in his efforts to gain support for decisive protective action, that the selective harvest of paired adult Brant may well lead to the extinction of small breeding populations. Since the former wintering Brant flocks on the British Columbia coast, like those of Puget Sound, appear to have comprised discrete populations from the Canadian Arctic islands, some populations may already have been wiped out. In short, the impact of hunting here on a species which pairs for life, is a major contribution towards the extinction of which Einarsen warned over a decade ago.

12. Geese Lost and Rare

The difficulty begins when we deal with those species which are variously termed vagrants, accidental visitors, lost or storm-driven wanderers . . . experience has proved that many that were formerly classed as accidental visitors are more or less regular on passage migration.

T. A. Coward, 1920

In addition to the Lesser Snow Geese, the various races of Canada Geese, and Brant, there are three other geese which occur in the lower Fraser Valley, the White-fronted Goose, the Ross' Goose, and the Emperor Goose.

White-fronted Geese are rather elegant birds. Adults have a conspicuous white front to the head extending from the base of the bill to the crown. Their light undersides are heavily crossed with irregular black patches; hence the local name "speckle-belly". The upper plumage is brown, with grey on the lower back and dark, almost black flight feathers. The bill is pinkish and the feet orange. Immature birds lack the white front to the head and black undermarkings. They are therefore, rather nondescript in appearance, and closely resemble juvenile blue-phase Lesser Snow Geese which can be distinguished mainly by their dark bills and feet. The White-front has a distinctive high-pitched, triple-noted call, which it repeats in flight, giving rise to the name "laughing goose". On the ground it also uses a range of deeper honkings and murmurings and large flocks, while feeding,

produce a sustained buzzing sound. The White-front is a grazing goose that, in its winter range, shows a preference for wet grasslands and marshes. However it will also fly into stubble fields to glean waste grains.

The population of this species on the Pacific Flyway breeds in western Alaska. White-fronted Geese pair for life and maintain close family groups, the young tending to remain with their parents until the next breeding season. As the young learn to fly the families assemble into flocks at feeding and loafing areas. In September they leave Alaska and fly down the Pacific Coast to the mouth of the Columbia River and other coastal marshes in Oregon and Washington, including Willapa Bay. Few remain long on the coast; the majority cross the Cascade Mountains to the Klamath Basin where the greatest concentration of these geese in North America takes place in October and November. Then they spread further south through California and into Mexico. Later they move north again by stages through March, April and May (Palmer, 1976; Bellrose, 1976).

The bones of White-footed Geese have been found in the middens of Indian villages of the Fraser Valley, but the history of this species since white settlement in the Lower Mainland, is quite brief. As already described, John Keast Lord saw "immense flocks" arrive during the spring and fall migrations on the Sumas and Chilliwack prairies where they fed on the wet grasslands in company with "Hutchin's Geese". Lord's observations were used by John Fannin in his check list, but Fannin was misled into the belief that the White-fronted Goose bred both on Vancouver Island and on the mainland. In 1904 Fannin's list was updated by his successor, Francis Kermode, who repeated Fannin's error about the breeding range of the White-fronted Goose, but added the information that ". . . Brooks has taken it at Sumas and Okanagan Lakes." (Lord, 1866; Fannin, 1891; Kermode, 1904).

When Brooks first arrived at Chilliwack in 1887 the visits of the White-fronted Geese were already sporadic. He recalled that they had been "numerous in the fall of 1904" when a few may have remained all winter. Spring visitors lingered as late as 3rd June. By 1917 it was "usually scarce" at Chilliwack, but in the *Distributional List* of 1925 he described the White-front as still "a common migrant along the coast where a few winter" (Brooks, 1917; Brooks and Swarth, 1925).

The record of its decline is continued in "The Birds of Vancouver District, B.C." in the journal *Murrelet* of 1932. Here R. A. Cumming listed the White-fronted Goose as a "scarce spring and fall migrant." In 1947 J. A. Munro and Ian McTaggart Cowan classed it as a "transient" in their *Review of the Bird Fauna of British Columbia*. Charles Guiguet reported in the *Waterfowl of British Columbia* in 1958 that a few White-

fronts occasionally winter along the Fraser River and mentioned sightings at Lulu Island, Canoe Pass and on the meadows beside the upper Serpentine River at Fry's Corner. He added that during migratory periods ". . . flocks are often heard passing over at night, and though small numbers are actually seen, a fairly large migration is believed to pass along the British Columbia coast" (Cumming, 1932; Munro and Cowan, 1947; Guiguet, 1958; Hatler, 1973).

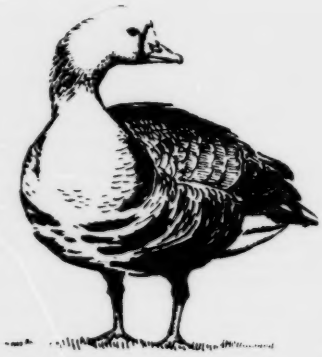
In October 1963 I saw 36 White-fronts fly in from Roberts Bank to feed on the open fields south of Canoe Pass. Their sudden, unmistakable call transformed the drab landscape. More recently small flocks of up to 22 have visited the sanctuary at Serpentine Fen. But most sightings are of one, two, or three birds, evidently stragglers from the migratory flights which now pass us by. Their present status in the reports published by the British Columbia Provincial Museum is "rare", which means "of regular occurrence but seldom seen."

Of all the North American geese, White-fronts range the farthest south. Even before white settlement in the Fraser Valley they were evidently transients here, pausing only to rest and feed before continuing their long migrations. Like the Taverner's Canada Geese, with which they consorted in their visits to Sumas Lake, the White-fronted Geese probably changed their migratory pattern not only because the situation in the lower Fraser Valley became unfavourable, but also because the irrigated agricultural lands, and later the waterfowl refuges, created only 10 to 15 hours flying time further south, rendered their stop here unnecessary.

Unlike the preceding species, the Ross' Goose was never a traditional visitor to the lower Fraser Valley. It occurs only as a casual wanderer. In appearance it closely resembles the Lesser Snow Goose, but is smaller with a shorter bill and neck, a quicker wing beat, and a higher pitched call. Its normal migration flights between central Arctic Canada and its main wintering grounds in the Klamath Basin and central California take it across eastern Alberta, Saskatchewan and Montana (Palmer, 1976; Bellrose, 1976).

Fannin included the Ross' Goose on his list in 1891 and stated that one had been taken at the mouth of the Fraser River. Brooks observed that "a very small Snow Goose frequented Sumas Prairie for about six weeks in the spring of 1896." It always associated with a flock of Hutchin's Geese and kept too far away from the small flock of Snow Geese that were present to enable him to compare their size with that of the smaller bird. However, he suspected that it was a Ross' Goose (Fannin, 1891; Brooks, 1917). Since then a few of these little geese have turned up in British Columbia. One shot on the shore of Westham Island in 1973 carried a band placed on its leg in Saskatchewan.

The Emperor Goose is even more of a stranger on the Delta. Its breeding range is limited to some northern coastal areas of the Bering Sea and it normally winters on the Aleutian Islands and a few other localities on the Bering Sea and the Gulf of Alaska. However, wanderers have been recorded as far south as Los Angeles County and the Sacramento Valley in California. In 1965 a single Emperor arrived in mid-winter on White Rock pier and returned there daily for several weeks. It repeated this performance every winter for seven years, sometimes lingering as late as mid-April. It fed along the neighbouring beach, mainly on seaweed, especially eel-grass, but it was also seen to nibble at barnacles (Leach, 1972; Campbell, Shepard and Drent, 1972; Bellrose, 1976).



13. Ducks of the Shallows

All along the back water,
Through the rushes tall,
Ducks are a-dabbling,
Up tails all!

Duck's tails, drake's tails,
yellow feet a-quiver,
Yellow bills all out of sight
Busy in the river!

Kenneth Grahame,
Wind in the Willows, 1908

The "dabbling ducks" are so named because they feed in shallows by using their broad, flexible bills. The upper and lower mandibles are edged with serrations called *lamellae* which, together with matching indentations on the tongue, are used to sift edible plants, seeds and small pond animals out of the water as it is passed rapidly through the bill in the process called "dabbling". Their bills vary from the Northern Shovelers' broad, soft, spoon-like equipage with its sieve of long hairy *lamellae*, to the American Wigeon's short, thick, cutting apparatus, with strong serrated edges adapted for grazing on water weeds and wet grasses. Most dabblers, like Mallards, Pintail, and the teals, use their bills both as sieves and for plucking soft plants. All the dabblers feed near the water's surface or in the bottom of shallows, so they are also called "surface-feeding ducks" or "puddle-ducks". Because they spend

much of their time standing on the ground or swimming on the surface of the water their legs are located at the centre of gravity of their long bodies. Their necks are also long, so that if they tip up on the surface of shallow water they can reach down to the bottom.

In October and November the number of dabbling ducks on the Fraser Delta rises daily. They come from the sloughs and potholes of the interior plateaus, from the river estuaries of the Arctic coast, and from the tundras of the Northwest Territories, Alaska and Siberia. Their journeys bring some up the valleys of the Yukon, Peace and Mackenzie Rivers and down the Chilcotin, Skeena, and Fraser Rivers. Others follow the Arctic shores, cross the Bering Sea, and skirt the forested coasts of the Queen Charlotte Islands and the mainland. For all of them, the Fraser Delta is a welcome stopping place after many hours of continuous flight. When they have rested, preened, and fed some will go on as far as Central America. In the spring, on the journey back, many will again use the Fraser Delta as a place for rest and replenishment for the demanding journey ahead.

Nobody knows exactly how many waterfowl pass through the Fraser marshes on each migration. Some say the total number reaches four million, others one or two million. Certainly, most ducks seen in the fall are transients. Tomorrow they may be in Oregon or California. But there are also some prepared to tarry longer, and a few thousand spend the whole winter at the mouth of the Fraser.

In spite of the dyking and draining of many former wetlands, there are still enough areas of both loafing and feeding habitat to support large wintering populations of ducks on the Delta. Boundary and Mud Bays contain 6,000 hectares of salt marsh and sand flats, Roberts and Sturgeon Banks embrace about 13,000 hectares. Duck and Barber Islands, which are undyked, contain several hundred hectares of vegetation similar to that of the Delta foreshore marshes. Upstream along the Fraser, remnants of marsh and tidal slough provide good duck habitat at Ladner Marsh, Tilbury Slough, Douglas Island, Surrey Bend, Katzie Swamp and McMillan Island. The Pitt River marshes are also of great value, even though dyking has led to a succession of plant growth which has reduced their productivity in aquatic plants useful to water birds. Ducks Unlimited and the Provincial Fish and Wildlife Branch are now trying to restore these valuable wetlands.

There are only a few shallow lakes or large ponds left on or near the Delta. The best for waterfowl is Burnaby Lake, which covers 136 hectares in the centre of a growing suburb of Vancouver. Its shore is lined with cat-tails, yellow iris, sedges and wooded swamps that provide nesting habitat for Mallard, Blue-winged Teal, Cinnamon Teal, Green-winged Teal, Gadwall and Wood Duck as well as for Canada Geese, American Bittern, rails, grebes and other marsh birds.

The natural marshes and lakes are now too few to provide sufficient food for the migrating flocks but they are matched by 70,000 hectares of farmland still regularly flooded or puddled by the heavy winter rains. Between October and January the combination of hunting and high tides by day encourages the dabbling ducks to leave the foreshore marshes to feed and loaf in the flooded fields. Most foods taken are wild seeds like those of smartweed, but the ducks also glean in the stubbles and arable lands for remnants of the previous summer's crop. Wigeon graze on grasses and clover, but the damage they do by trampling and "puddling" is probably greater than the loss of the forage they eat (Burgess, 1970; McLaren, 1972).

Studies conducted by Dr. Janet Kear of the Wildfowl Trust revealed that pasture grazing in winter does not harm established grass, but may in fact improve the sward by encouraging tillering, the generation of new shoots, and the spread of clover. The close-cropping of grasses in winter also improves their nutrient value. Most tall growth consumed would be destroyed by frost anyhow. Grazing on winter cereals also does more good than harm by firming the roots, increasing tillering and reducing premature top growth. In Europe, the practice of allowing sheep to graze-off winter cereals developed for these very reasons. By late April, when grazing could damage new growth, the great masses of waterfowl are already on the way to their breeding grounds (Kear, 1963; Murton, 1971).

Abnormally high concentrations of ducks in limited areas can, however, cause serious loss to winter crops, especially if over-grazing is followed by uprooting. Hunting is the best insurance against overuse of specific areas of farmland by waterfowl, and a close liaison between the farmer and the hunters who shoot on his land pays off when crops are endangered. The provision of attractive habitat and the growing of "lure crops" in sanctuaries is also a proven method of keeping ducks off the farmers' fields. This is done in the two small sanctuaries at Reifel Island and Serpentine Fen, but these are not sufficient to meet the need throughout the Fraser Valley.

The most important farmland feeding areas are those closest to the estuarine marshes on Sea, Lulu, Reifel and Westham Islands, and on the mainland south of Ladner, along the shore of Boundary Bay and in the valleys of the Nicomekl and Serpentine Rivers. Further up the Fraser Valley flocks of dabbling ducks are attracted to the broad fields of corn stubble and meadow grass in Sumas Prairie.

Between September and April there is constant traffic between the various loafing and feeding areas in the Lower Mainland. Large numbers of ducks are also moving into or out of the valley on migration. The Canadian Wildlife Service, using aerial counts made between 1966 and

1975, estimated the numbers of dabbling ducks on the inter-tidal marshes and flats of Roberts and Sturgeon Banks and Boundary Bay as follows (Vermeer and Levings, 1977):

Average Number of Dabbling Ducks Observed (in Thousands)

	Late Sept.	*Early Oct.*	*Late Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.-Apr.*
Mallard	1	4	11.5	13	17	7	2.5
Pintail	3	6	10	17	18	6	3
Green-winged Teal	3	3	6.5	11	3	1	2
American Wigeon	9	8	15.5	18	17	10	4
Total	16	21	43.5	59	55	24	11.5

Maximal Number of Dabbling Ducks Observed (in Thousands)

	Late Sept.	*Early Oct.*	*Late Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.-Apr.*
Mallard	2	9	38	50	52	33	6
Pintail	6	12	18	35	42	14	8
Green-winged Teal	6	8	18	54	9	1	4
American Wigeon	17	16	26	61	58	54	6
Total	31	45	100	200	161	102	24

The distribution of the four main wintering species on the foreshore differs markedly. Wigeon show a preference for Sturgeon Bank. Green-winged Teal seem to prefer north Roberts Bank and Mud Bay. Pintail are most numerous on Boundary Bay, and Mallard are fairly evenly distributed throughout the tidal marshes (Campbell, Shepard and Drent, 1972; Munro, 1943; Munro, 1944). These preferences contribute to the seasonal fluctuation in numbers. This is evident on Boundary Bay and south Roberts Bank which are mainly loafing areas for ducks which come in over the dykes to feed on the farmlands. However, when the flooded fields freeze over the ducks move south because the shoreline marshes of Boundary Bay and south Roberts Bank offer very little alternative feeding opportunities. An abnormally dry spell in the winter will have the same effect. The Pintail and teal just disappear because they are no longer attracted to farmlands without flood water.

The populations of Sturgeon Bank and north Roberts Bank are more stable because the foreshore marshes there are abundant in foods. The seeds of sedges and bulrushes produced there, and also the mass of plant and animal life from the Fraser River's water is filtered by the marsh plants as it fans out through the delta.

The feeding is especially rich in late fall and winter when increasing rainfall washes great quantities of duckweeds and plant seeds from

the drainage ditches on the farmlands. High tides in December enable dabbling ducks to penetrate the foreshore marshes and find floating foods right up to the dykes. But, except on the sanctuary at Reifel Island, they can seldom take advantage of this situation, and during the hunting season from October to January they rely more upon the open farmlands as a source of food. Here they are not as easily found nor approached, and by November when the rains turn the meadows and fields into marshes and flood the ditches the feeding is as good as that on the foreshore.

Fortunately dabbling ducks will, if necessary, feed at night. As a result during the hunting season most of them sleep by day on the calm waters or sand flats of Boundary Bay and Roberts and Sturgeon Banks and come into the flooded fields only after sundown. Even on the darkest night the lights of Greater Vancouver reflected off low clouds provide illumination for the ducks' needs. Shooting after sundown is forbidden by law, so peaceful nights on the meadows and marshes offer some compensation for the hunting pressure by day. But when ducks are exhausted by long migratory journeys, driven off the sea by storms during the day, or forced off the fields by frost or snow they need some haven for rest and food on the tidal foreshore marshes. At such times the presence of duck hunters on the foreshore becomes a significant factor in determining their numbers in the Lower Mainland. There can be little doubt that, like many of the geese which formerly wintered in the lower Fraser Valley, large numbers of dabbling ducks are sufficiently disturbed to quit the delta and fly to quieter marshes further south, especially those in the National Wildlife Refuges in Oregon and California. These places are not completely closed to the hunter. On the contrary, large tracts are designated as shooting areas. But unlike the Fraser Delta marshes they are matched by extensive sanctuaries which ensure that the several million waterfowl on the

Pacific Flyway can adhere to their daily and annual life cycles. The area of wetlands in the Fraser Delta is, of course, small compared with any one of these vast refuges. Nevertheless, this delta makes an important contribution to the migratory pattern on the Pacific Coast, and the present tiny sanctuaries are not enough to ensure that it can maintain that contribution in the future.

The lower Fraser Valley is not an outstanding breeding area for dabbling ducks. Fluctuations in the level of the river in spring and early summer obviously place limits on the available breeding habitats. Nevertheless, considerable areas of swamp and many large ponds and lakes which once existed beyond the reach of the river offered nesting opportunities for several species. Clearing and draining of such habitat in the second half of the nineteenth century greatly reduced the summer population of waterfowl. However, during the last two decades man-made habitats, such as drainage ditches, sewage lagoons and ponds in parks and bird sanctuaries, have resulted in a revival of the breeding populations of several species.

The checklists published by the Provincial Museum in 1891 and 1904 gave very little information about the breeding distribution of ducks. The Mallard, as might be expected, was described as an abundant resident throughout the province, breeding in suitable localities throughout its range. Subsequent writers described its status in a similar vein, though by 1932 R. A. Cumming stated in his list of the birds of the Vancouver district that only ". . . a few pairs nest locally."

The decline of nesting ducks in the Fraser Valley was also apparent in the change in status of the teal and Northern Shoveler. Allan Brooks witnessed the decline and stated that in the 1880s the Cinnamon Teal used to be the commonest breeding duck after the Mallard; the Blue-winged Teal was also "a fairly common summer resident—very common in 1887." However, both species had become scarce by 1917 because ". . . by far the greater proportion of the nests were destroyed each year by the rise of the Fraser River in June." He added that if the Cinnamon Teal reared second broods ". . . they fell easy victims to duck shooters as the young, as a rule, could not fly when the season opened." The last Blue-winged Teal he saw was an adult male in June 1896. He made similar comments about the Northern Shoveler, which ". . . used to be a common breeder, (and is) now only a migrant owing to the draining of the upland swamps and the inundating of the lowlands" (Brooks, 1900; Brooks, 1917). It is easy to see how the loss of the swamps at higher elevations affected the nesting ducks, but the lowlands had always been inundated by the river in June. We have John Keast Lord's description of how the flow of the Sumas River reversed and flooded Sumas Lake and Prairie. It is, therefore, difficult to see how the nesting opportunities for dabbling ducks worsened at the very time that the Fraser's flood plain was being dyked. Probably

the areas formerly most favourable for successful nesting lay just above the normal flood level around the outer fringe of the "prairies" and on "islands" of higher ground. After white settlement, such areas were cleared of debris, heavily grazed and trampled. As a result ducks were pushed into the grasslands and marshes below the normal flood level, and so what Brooks witnessed in the 1890s was their last effort to remain close to traditional habitat.

The return of the three species of teal has been a gradual process of adaption to the new habitat offered by drainage ditches and pastures in the agricultural lands throughout the valley. Northern Shoveler, which prefer larger bodies of water like Burnaby Lake and stands of emergent flags or reedy growth, are less numerous. But they have re-established themselves in places like the Iona Island sewage lagoons, Reifel Migratory Bird Sanctuary, and Serpentine Fen.

The Green-winged Teal which was described by Brooks with the words "Common resident—breeds," was probably more affected by the loss of the swamps and beaver ponds. It seems to favour nesting sites in bushy areas with acidic water conditions. I have seen these teal with ducklings in Burns Bog and Langley Bog. The number nesting at Reifel Island increased when ponds were dug in the sanctuary and, at Serpentine Fen, where the soil is peaty, they are more numerous nesters than either the Blue-winged Teal or Cinnamon Teal.

According to Brooks, the Pintail used to breed in the Chilliwack area. But like other dabbling ducks it ceased to nest there in the last decade of the nineteenth century. In 1948 it was reported as a more frequent nester at Reifel Island than the Northern Shoveler and Blue-winged Teal. A pair nested at Serpentine Fen for three successive years, until 1968. In that year three pairs hatched a total of 16 ducklings at Iona Island. Pintails have continued to nest there, and also at Reifel Island, where several pinioned birds have bred (Tener, 1948; Leach, 1972).

Human aid has also been given to the Gadwall, which was not known as a breeding duck in the Fraser Valley until the 1960s when it began to nest at Burnaby Lake, at the sewage lagoons at Iona Island, and at Reifel Island. In 1975, 108 Gadwall from Saskatchewan were released at Serpentine Fen and in the Pitt Valley. They were banded and marked with light blue, plastic "nasal saddles" which clip over the upper bill. In May, five pairs were seen to have established territories on the Fen and one pair on the Serpentine River. In July broods of one, three, and seven ducklings were seen. Five of the marked birds were shot by local hunters: two in Mud Bay, one in Surrey, one at Haney, and one on Westham Island. Other marked Gadwall were recovered at Duck Lake (near Creston) and at Lac La Hache, in British Columbia, and one each in Washington State and Nevada (T. Sterling, Ducks Unlimited; pers. comm. in 1977).

Gadwall were the most numerous ducks found on the tidal flats in the course of surveys conducted by the Canadian Wildlife Service between May and July 1974. Four hundred were seen at Iona Island Jetty. The sum of the other dabbling ducks on the foreshore totalled only 100 until July 25 when 1,500 Pintail were seen. A month later the number of Pintail reached 5,500. By the last week of September many of these late-summer Pintails moved on and American Wigeon become the most numerous ducks on the delta marshes (Vermeer and Levings, 1977).

There is no record of wild American Wigeon breeding successfully in the lower Fraser Valley. A nest was reported on Burns Bog in 1975 but the eggs were stolen. However, pinioned birds of this species have bred successfully at Reifel Island for several years so they may become established as a nesting species on the delta.

Wintering flocks of American Wigeon are worth close examination because they sometimes include a few European Wigeon. The drake is a striking bird with a chestnut head and yellow forehead, and a pinkish mauve breast. The female is indistinguishable in the field from that of the American Wigeon. Often, the presence of these birds in a flock may be revealed by their very clear whistle, which is less "wheezy" than that of our "Baldpate." At Westham Island a dozen drakes were counted in a flock of 2,500 American Wigeon. Several have also been identified at Stanley Park and in other locations in the delta.

Another wanderer from Eurasia is the Eurasian form of the Green-winged Teal. This bird, the Common Teal, is even more difficult to spot in the field and was only noticed for the first time in 1967. The best field mark on the drake is the long white streak on the scapular feathers of the shoulder and the absence of the white crescent between the breast and flank feathers which distinguishes the Green-winged Teal. Like the wigeon, their females appear identical in the field. This species has been reported at various locations across the delta from Iona Island to Crescent Beach and the Campbell River at White Rock (Campbell, 1967).

14. The Wood Duck, Most Colourful of All

British Columbia, however, is unwilling to accept . . . the provisions of Articles 3 and 4 in so far as they would restrict the killing of cranes, swans, curlews and wood ducks.

Commission of Conservation, Canada, 1916

Unfortunately the two million or so of our citizens who hunt ducks have not been willing to exempt from hunting even this one rather small species so that the 150 million of us who do not hunt can have it around in abundance where we can enjoy its beauty.

Richard Pough, 1951

The Wood Duck is a special bird. Although in appearance and feeding habits it resembles the dabbling ducks, it is a member of the tribe *Cairinini*, the perching ducks and geese. It shares this distinction with two of the most beautiful of the waterfowl, the Mandarin Duck and the African Pygmy Goose, and also two of the most ugly, the Muscovy Duck and the Comb Duck.

The drake Wood Duck vies with the Mandarin in the beauty of its nuptial plumage. Even at a distance its trailing crest, white throat and flank markings, give it a distinctive appearance. Close at hand the green, purple and bronze feathers show an iridescence which adds

further variety to the already rich mixture of colours it carries. Although dull by comparison, the female is a neat and attractive little duck. In the contrasting light and shade of woodland waters, neither bird is conspicuous. They are often overlooked until they rise and twist through the trees as the female repeats the distressed, squealing alarm note, a drawn-out *whoo-e-e-e-k, whoo-e-e-e-k!*

The Wood Duck's preference for wooded lakes and swamps, tree-lined rivers, backwaters and ponds made it the most generally distributed of the ducks nesting in the forested parts of the Fraser River's flood plain. It was nowhere abundant. When Allan Brooks first arrived at Chilliwack in 1887 it was "rather scarce." It increased each year and by 1895 it was "very abundant." Then it decreased again but remained a regular breeder in the valley (Brooks, 1917).

The Wood Duck nests in tree cavities, especially the holes of Pileated Woodpeckers and the Flickers, in drowned trees standing in beaver ponds. The felling of trees along the rivers, the draining of swamps and lakes and beaver ponds, and the clearing of bottomland all seriously reduced its habitat early in the twentieth century. R. A. Cumming noted that it had disappeared from Lulu Island in 1922, but reported that it was still "nesting abundantly at Pitt Lake" in 1932, and in July of the same year 21 broods were counted at Chilliwack (Cumming, 1932; Munro and Cowan, 1947).

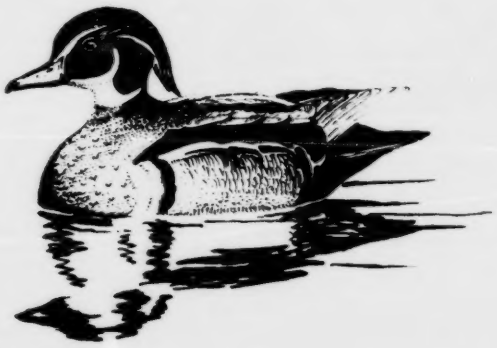
The Wood Duck's recent return to much of its former habitat has been due in part to the fact that in the early 1960s the Vancouver Natural History Society and concerned individuals began putting up nest boxes for Wood Ducks at Stanley Park, Burnaby Lake, Reifel Island, and in the Pitt Valley. At Burnaby Lake, 15 of the first 18 boxes put up were occupied. But the rivalry of the European Starling has become an increasing nuisance. At Reifel Island, Starlings occupied 50 of the 62 nest boxes, including 9 in which Wood Ducks had already laid eggs. Only 5 were used by Wood Ducks alone (Campbell, Shepard and Drent, 1972). Elsewhere rivals included a northern flying squirrel, Screech Owls and, at Burnaby Lake, Hooded Mergansers.

The biggest project for the increase of the Wood Duck was started in 1971 by the Pitt Waterfowl Management Association (Trethewey and Cooper, 1975). In the following four years the members of this association constructed and set up 1,700 nest boxes. These were placed in groups to facilitate monitoring. Fortunately, Starlings seldom occupied all the boxes of a group if they were fairly close together.

At the same time a permit was granted to conduct an experimental hatching program. Eggs were taken from nest boxes at the association's headquarters at Coniagas Ranch near Maple Ridge. These were hatched under chickens, reared and held in pens, and released in selected areas the following spring. The purpose was two-fold: first, to

reduce the loss of birds to predation and to accidents over the winter; second, to re-establish nesting populations in suitable parts of the Fraser Valley. In 1973 eggs were also taken on Douglas Island and, in 1975, permission was obtained to extend the collecting to areas throughout the Lower Mainland. The collection of eggs was carried out as early in the spring as practicable in order to increase the chances of re-nesting by the robbed pairs; 648 eggs were taken.

In the course of collecting, the volunteers found that Wood Ducks frequently started nests and then abandoned them. Some boxes contained "dump nests" where eggs were laid by several ducks but never incubated. Usually clutches were not taken until they seemed to be complete. Starlings frequently nested on top of Wood Duck's eggs, and in the course of the program at least 4,000 eggs and young of Starlings were removed to prevent criticism of the program from local berry farmers.



In 1975, 1,012 boxes were inspected between Agassiz and the coast. Wood Ducks had started to nest in 325 boxes. Of these 230 were successful and contained a total of 2,883 eggs; an average of 12.5 eggs per nest. The number of unhatched eggs indicated an average hatch of 10.5 ducklings. In addition, 648 eggs were collected from early nests or from nests believed to have been deserted; 426 of these were hatched under chickens.

Losses among the captive ducklings were high during their first few days because many failed to start drinking and ignored the chick-starter and grated hard-boiled egg provided as food. However, it was noticed that the ducklings began to peck at food particles which fell on the backs of their companions, presumably because they would normally have been feeding mainly on moving insects and small pond

animals. In this way the ducklings were induced to start feeding. After further losses due to trampling, chilling and predation, 290 fully grown Wood Ducks survived until the following spring. The stumps of their clipped primaries were then pulled out in order to trigger the growth of new ones. When they were ready to fly the birds were released in selected areas of suitable habitat provided with nest boxes.

Critics of the program regard the total of 290 birds released as a poor result for the effort required. They suggest that it would have been better to have left the eggs in the nests. This ignores the facts that many were from deserted nests and that the others were replaced by second broods which otherwise would not have been raised. The hatching and rearing results compare favourably with similar projects in the United States. The lack of evidence of survival of banded birds makes it difficult to assess the program in precise mathematical terms. Nevertheless, the high occupancy rate of nest boxes in 1975 in areas throughout the Lower Mainland including White Rock, Surrey and Langley where Wood Ducks had become comparatively rare, indicates that the program broadened their distribution both by the re-introduction of reared birds and by the provision of nest boxes. Even without the rearing and release program, the presence of over a thousand artificial nest sites in 1975, in which 230 ducks successfully hatched over 2,400 ducklings is a notable achievement of the Pitt Waterfowl Management Association and the many volunteers who helped carry out the program. An extension of this work in 1977 resulted in the collection of 1,500 eggs mainly at White Rock, Coniagas Ranch and Douglas Island in locations that a few years earlier would have yielded only a fraction of this number.

In spite of the success of nest boxes, there are dangers in their use. They are conspicuous and therefore vulnerable to predators, especially those that learn that an easy meal can be obtained in them. The raccoon is the most serious threat but, the opossum, although only recently introduced, is probably now as numerous and no less of a menace. Both are agile climbers and can be prevented from reaching nest boxes only if a protective metal shield is placed around the pole. Raccoons of over 5 kilograms are said to be unable to enter an elliptical entrance hole 10 centimetres wide and 8 centimetres high. It seems unlikely that this minimum-sized entrance will exclude the opossum which is usually the smaller and leaner. Thus nest boxes in trees or on unprotected poles may be death traps for Wood Ducks, especially as boxes become old and their lids warp and work loose. Such boxes are better taken down when they are no longer tight. However, predation has not so far become a major problem in the Lower Mainland.

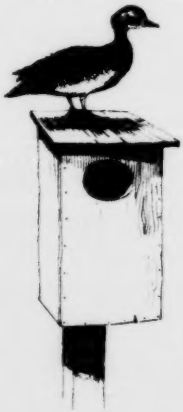
The best site for a Wood Duck box is on a pole set in water and protected by a 75-centimetre metal cone or by sandwiching the pole between two 25-centimetre wide, 100-centimetre long, sheets of metal.

Cylindrical metal drums set horizontally are not attractive to Starlings but must be protected against other predators. These structures with their metal protectors do nothing for the aesthetic appeal of the marshes and are especially undesirable in parks or "natural areas".

All nest boxes should have about 10 centimetres of sawdust or wood chips to provide a warm, dry floor inside. The wall inside below the entrance must be of rough texture to ensure that the day-old ducklings can climb out using the small hook temporarily present on the backs of their legs. Ducklings which fail to make the climb are left to die in the box.

Wood Ducks will occupy nest boxes on quite small bodies of water provided that there is adequate food and cover for their broods when they leave the nest. Swampy, tree-lined pools of variable depth, with emergent water plants and shrubs, interlaced with a network of open waterways, are particularly attractive. But the water must be sufficiently extensive and deep throughout the summer to provide protection against natural and domestic predators, including dogs and cats.

Ultimately the survival of the Wood Duck throughout the Lower Mainland will depend upon the maintenance of its habitat. Fortunately many publicly owned lands already provide a firm basis for the conservation of this handsome species. In addition to places already mentioned, the regional park at Derby Reach and the swampland to the south of it owned by the municipality, the regional park at Campbell River in Langley, and above all the unique combination of swamps, bogs, and fresh-water marshes in Surrey Bend, all contain areas which could remain ideal habitat for this duck if they are suitably managed.



15. The Deep-water Ducks

There is a rapture on the lonely shore,
There is society, where none intrudes,
By the deep sea, and music in its roar.

Lord Byron, *Childe Harold*, 1812

The conservation of waterfowl usually reflects concern for the ducks most sought after by hunters—the dabbling ducks. The diving ducks get little consideration. Yet outside the breeding season they gather off the coast of the Delta in thousands and are far more often seen by most people than the dabbling ducks because they are a familiar sight at all beaches from Stanley Park to White Rock. Furthermore, they deserve more concern than they receive at present because their coastal habitat is endangered both by the growing threat of major oil spills in the Strait of Georgia and by the gradual deterioration of the marine shore environment due to the ever-increasing number of small boats and marinas on the Lower Mainland coast (Institute of Environmental Studies, 1977a).

The diving ducks are adapted to feed under water. Compared with dabbling ducks they are more rotund and stocky. They have shorter wings and a quicker wing beat, and larger feet with a lobe, like a small paddle, on the hind toe. Their short, strong bills are adapted for grasping tough foods on the bottom of lakes and coastal waters. There are reports of diving ducks caught in fishing nets at depths of between 25–30 metres, but normally they feed at 3–10 metres (Coward, 1920).

Most diving ducks spend the greater part of their lives on the sea or on large lakes, and come inland only to breed. As a result they are often referred to as "sea ducks". The most conspicuous of them are the large, black scoters often seen in groups, sometimes totalling hundreds of birds, floating a short distance off shore, or flying swiftly in long lines strung low across the water. Scoters feed mainly on molluscs, especially mussels and small clams, and crustaceans which they crush with their thick bills (Vermeer and Levings, 1977). They dive without warning or splash, and swim with powerful lateral strokes of their broad feet using their half open wings and alula as stabilizers. The duration of each dive is from 15 to 50 seconds, depending on the depth and quantity of food available. However, they can remain under for 3 minutes.

The commonest scoter on this coast is the Surf Scoter, with a wintering population of up to 5,000 birds spread along the shores of Semiahmoo and Boundary Bays and the Strait of Georgia. A mass departure takes place during the last week of May when the flocks rise from the water and circle in the clear evening sky to gain altitude for their flight to their breeding range between northern British Columbia and the Arctic Ocean. Two or three thousand non-breeding birds remain throughout the summer. Ninety per cent of them are sub-adult males, distinguishable by the conspicuous white patches on the forehead and nape, and by the massive, strikingly coloured, yellow, orange, and white bill, with a large black spot near the base. In August their numbers in Boundary and Semiahmoo Bays increase to almost 10,000 as the southward movement begins.

The White-winged Scoter is the largest duck commonly found on this coast. It has a broad white wing-patch and the drake has a white patch around the eye. This species arrives in October and stays in flocks of up to several hundred birds. Numbers dwindle through April and May as adults migrate to their breeding range which extends from the interior of British Columbia to North Dakota and northwards to the Arctic. A few remain through summer, especially in Boundary Bay.

The Black Scoter occurs much less frequently than the other two scoters. It is unusual to see more than a score or two of these inconspicuous birds. The male has a large yellow knob at the base of the bill, the female has light cheeks, but neither of these features are distinguishable at a distance. These scoters favour rocky shores which they often share with Harlequin Ducks. Year after year they may be found wintering in the same locality. One favourite spot is the rocky shore below Kwomais Point at Ocean Park. This species nests in a narrow belt along the Arctic coast of Alaska extending to the Mackenzie Delta.

On the Atlantic coast the scoters, also called "black ducks" or "coots", are hunted with some enthusiasm, but on the Pacific seaboard

they have never been a popular quarry. They are not very palatable, and the coast Indians who, according to Allan Brooks, ate "gulls, guillemots, and even eagles" rejected them as food. Similarly the scaups or "bluebills", which are prized by duck hunters in the east, are not much sought after on the Fraser Delta. Their large numbers at sewerage outlets doubtless does little for their reputation as a table bird. They eat more seaweeds and algae than the other "sea ducks".

The two species of scaups are difficult to distinguish when on the water. The Greater Scaup is slightly larger, has white flanks and a rounder head glossed with green. But in poor light at a distance the smaller size, grey flanks and purple head gloss of the Lesser Scaup are not very apparent. In flight the Greater Scaup shows a bar of white extending over most of the main flight feathers or primaries. On the Lesser Scaup the white wing-bar is confined to the secondaries.

Both the Greater and Lesser Scaup winter on the Lower Mainland coast. The former is the most numerous; its numbers may increase to over 30,000 in Boundary Bay between mid-October and December. During the rest of the winter 3,000–4,000 remain. The annual bird counts in Vancouver and White Rock usually each report 2,000–3,000 Great Scaups and 300–400 Lesser Scaups. Several hundred scaups remain on the coast when the rest depart in the spring. The Greater Scaup breeds in the Arctic, and the Lesser Scaup nests in the Cariboo and the prairie provinces.

The two species of goldeneyes are easier to distinguish than the two scaups. The Common Goldeneye has scapulars, or shoulder feathers, streaked with white and a round white patch on the forecheek; Barrow's Goldeneye has small patches of white on its scapulars and a large crescent-shaped patch before the eye. Both are common on rocky parts of the coast. December bird counts reveal that the Barrow's usually outnumber the Common Goldeneye, and that there are many more of both species on the north side of the delta, around Vancouver, than to the south at White Rock.

Both species are active feeders often diving after small crabs, shrimps, shellfish, and aquatic insects and plants for periods of over 20 seconds and spending only three or four seconds on the surface. When alarmed they dive and swim away under water and on re-appearing take off with less effort than do other diving ducks. They fly low across the water, producing a loud whistling sound with their wings which gives rise to the local names "Whistler" or "Whistlewing". In their courtship display the goldeneyes show the same vigour as in feeding. They bow, jerk up and down, throw back their heads, and hurtle forward kicking up water with their feet.

The breeding range of the Common Goldeneye extends right across the continent southwards to the northern tier of states and as far northwards as there are trees large enough to provide nesting holes. This species has nested in the Lower Mainland (Brooks and Swarth, 1925). The Barrow's Goldeneye has widely separated breeding ranges in Iceland, Greenland and in western North America from Alaska through the interior of British Columbia to Washington. They are also tree-hole nesters, and the ducklings often suffer heavy predation on their journey from the nest to the nearest water.

Another tree nester is the Bufflehead, smallest of the diving ducks. It breeds from Hudson's Bay to Alaska, through the interior of British Columbia, and down the Rocky Mountains to California. Brooks found a female with three half-grown young at Sumas Lake, but as yet no nest has been found in the Lower Mainland (Brooks, 1917). It is known as "butter-ball" due to its chunky build and heavy accumulation of fat in the fall. Throughout winter it is very common on salt and fresh water, and is often seen in roadside ditches and small ponds a few yards wide. Because the wintering population is so scattered it is very difficult to assess its size. December counts at Vancouver and White Rock usually average between 400–500 and 150–200 respectively. By early May this species has departed and is rarely seen on the delta in the summer.

The handsome Oldsquaw is a circumpolar species, breeding on the Arctic tundras of North America, Eurasia, Iceland and Greenland. Some go as far north as 83°, only 500 miles from the North Pole. In their winter habitat they feed well offshore and seem quite unperturbed by

rough weather. Large numbers were once caught in nets in the Great Lakes and used for fertilizer. In 1917, an investigator found 12 tons of carcasses in one factory, an estimated 18,000 birds. In 1934 Allan Brooks reported that the numbers of Oldsquaws on the waters around Vancouver Island had fallen to about 10 per cent of their former abundance. As it was not hunted in this region, he attributed the drop in population to losses on nesting grounds (Brooks, 1934). Today Oldsquaws are frequently seen on the Lower Mainland coast, usually in scattered flocks of between 5 and 50, feeding on sand clams and crustaceans in the deeper water beyond the large concentrations of scoters and scaups. They are noisy and have a distinctive cry which has given rise to a large number of local names, such as "Calloo" and "Coal and candle light" in Scotland, and "South-south-southerly" in New England.

Another handsome bird frequenting the rocky shores of the Lower Mainland is the Harlequin Duck. The beautiful plumage of the drake is best seen at fairly close range, and is often missed because they tend to move offshore when approached. They nest by streams and rivers in mountains as far east as Alberta. Males leave their brown mates to rear the broods and by mid-June are back on the coast in gaudy groups on the rocks where they loaf and moult near their feeding areas in the tidal shallows. I have seen over 80 in such a group near White Rock. In the winter small flocks of Harlequins gather among other "sea ducks" along the coast.

The Ruddy Duck is made conspicuous by its small size and comical, dumpy shape. It is almost a caricature of a duck, and is as pugnatious as its squat body, bristling tail, and upturned bill suggest. It winters along the coast on tidal sloughs, normally in flocks of up to 50, but gatherings of several hundred are also seen. It seems to be increasing because even in the 1930s it was regarded as uncommon here. A

few pairs occasionally nest in the lower Fraser Valley beside the sewage lagoons at Iona Island and at Burnaby Lake. In spring the male conducts a vigorous courtship display. In spite of her small size, the female lays large eggs and often raises two broods. Unlike other ducks she is attended by the male throughout the nesting period.

The Canvasback and Redhead both nest on the prairie and in the aspen parklands. In British Columbia their main summer range is in the Cariboo, but some pairs of both species nest in other suitable parklands of the southern interior. The Canvasback winters in small flocks at Sea Island, Reifel Island, Lost Lagoon, Crescent Beach and on the upper Nicomekl River in Langley. It was formerly far more numerous. Brooks and Swarth (1925) reported it a common winter visitor to the southwestern coast, remaining all winter wherever open water and suitable feed were available. They specified the mouth of the Fraser and Boundary Bay as places of common occurrence. It was also "irregularly common" at Sumas Lake. After the draining of the lake numbers of these ducks still returned annually to the small remnant left at the southern base of Sumas Mountain. Here the game book of the Lakemount Hunting Club records the diminishing numbers of Canvasbacks shot: 1930—61; 1931—39; 1932—27; 1933—5; 1934—3. Cumming (1932) described them as "not common" in the Vancouver area. But occasionally large numbers occurred, as in November 1942 when about 2,000 were reported at Reifel Island. Usually the numbers wintering since the 1940s were one or two dozen at various locations across the delta and at Langley Prairie. Harry Weaver once shot 12 Canvasbacks with a single cartridge off Blackie Spit. Today you are lucky even to see a dozen there. The total wintering population on the Lower Mainland seldom exceeds a couple of hundred (Munro and Cowan, 1947; Campbell *et al.*, 1972).

The Redhead appears here in even smaller numbers and seems never to have been more than an occasional winter visitor. Brooks had only four records at Sumas in 1917. So the flock of 61 seen on Pitt Lake in February 1972 was an exceptionally large number of these ducks for this area. The drakes of the Redhead and Canvasback are easily distinguished, for the latter has flank and back feathers of such light grey that they appear white at a distance. The long bill and sloping profile of the Canvasback is the best identification feature of both sexes.

The Ring-necked Duck is a rare winter visitor seen in small numbers, most frequently on Nicomen Slough and on Lost Lagoon in Stanley Park which is under constant observation. I have seen a pair in the spring near Pitt River in 1977 and at Serpentine Fen in 1978, but there is no record of this species nesting in the lower Fraser Valley. This bird is also called the "ring-bill", which seems a much more appropriate name because the white ring on the bill is far more conspicuous than the dull chestnut ring in the dark plumage of the neck. The black

back of the drake Ring-necked Duck marks it out from the scaups. The only other duck of this genus similarly coloured is the Tufted Duck, a very rare wanderer from the Old World that has also been seen on Lost Lagoon.

Observers there have spotted another rare vagrant, the Smew. This bird was seen for the first time in British Columbia in November 1970. The Smew is a small merganser or "saw-billed" duck. Although several species of ducks will occasionally eat fish, the mergansers are the only one which depend on them as their main item of diet. Their long, narrow bills, with sharply serrated edges and hooked nails at the tip, are well adapted for seizing and holding their slippery prey. To achieve speed for underwater pursuits the mergansers have long muscular streamlined bodies. Their length, together with the large amount of white on their plumage, gives an elegant appearance.

Three species of merganser are usually found in the Lower Mainland. The most common is the Red-breasted Merganser which nests near lakes and ponds in the northern forests and winters on the coast between September and April. It is usually seen singly or in pairs among the diving ducks along the shores. They dive for fish, especially sandlance, and for crustaceans, but in shallows they swim with only the head beneath the surface picking small sea creatures from between the pebbles. When disturbed they submerge or dive, and if alarmed they scutter along the surface and take off. Once airborne they are swift and direct in flight. In early spring drakes engage in courtship displays before females, raising their breasts, tilting up their bills and stretching their heads and necks back between their shoulders. Rival drakes are driven off in a great flurry of splashing.

The Common Merganser is the largest of the "saw-bills". It prefers fresh water in winter and small flocks may be seen on the Lower Mainland rivers between October and April. The drakes' white neck, underparts and wing-bars make them conspicuous, especially in flight, when they sweep low and fast along the river, often uttering a harsh grating call. Females lay between eight and twelve cream-coloured eggs in a rough nest located in a tree cleft or rock crevice.

The small Hooded Merganser is a tree nester, favouring habitat similar to that of the Wood Duck. It was once a more common nesting species on the wooded streams and beaver ponds in the lower Fraser Valley. Its reduction is due to several factors: loss of habitat resulting from the trapping of the beaver and the clearing of land; the deterioration of water quality; the dropping of summer water levels in the small rivers and the draining of lakes. Up to 1932 R. A. Cumming had recorded only one nest in the Vancouver area, that at Seymour Creek, in July 1913. In May 1970 a female was found incubating nine eggs in a nest box at Burnaby Lake (Campbell, Shepard and Drent, 1972). In 1971

I saw a Hooded Merganser fly into a Flicker's nest hole beside the Nicomekl River and two weeks later observed her in the same locality swimming with three downy young. Although I watched the river frequently I never saw the drake. These birds are shy, and in spite of their handsome plumage they are not conspicuous in the shady waters they inhabit in summer. This species is still quite common on quiet, secluded pools and streams just across the international border in Washington.

PART THREE: PLACES AND PROJECTS

I have seen scientific ornithologists with dates and numbers forever on their lips gazing in wonder at the morning flight and the pattern of geese that seems to fill the sky when they circle down into the green marshes. Then I have wondered which came first—the sentiment or the science, because surely one without the other would have been directed elsewhere.

Keith Shackleton, *Tidelines*, 1951

16. Reifel Island Sanctuary

. . . people who offer wild geese hospitality are doing a great service to wildfowlers as well as to bird-lovers . . . So great a part of the life of the average wild goose is spent in gun-dodging, that a respite from it, however small, is very welcome.

Michael Bratby, 1939

In the summer of 1960 I spent a few days with H. Albert Hochbaum at the Delta Waterfowl Research Station on the southern shore of Lake Manitoba. One evening, after my return from an exciting tour of part of the 17,000-hectare marsh beside the station, Al was explaining some of the problems of keeping captive waterfowl through the hard prairie winter. He casually mentioned that Peter Scott, Director of the Wildfowl Trust in England, had once expressed the view that Vancouver's climate and geography made it the best location in Canada for a waterfowl park. But it was not until a windy afternoon in November that the truth of that remark came home to me. For it was then that I saw the Snow Geese for the first time.

Unfortunately, what I also saw on the seaward side of Lulu Island's sea dyke were abandoned cars, rotting potatoes, mouldy mattresses and every conceivable sort of garbage dumped by people who evidently had neither respect for marshes nor love for the life in them. This prompted me to draw up a proposal for the establishment of a "Snow Goose Park" as a first step towards the encouragement of a greater public appreciation of the wildlife of the Delta. When I showed it to Fred Auger, President of Ducks Unlimited (Canada), he understood exactly what I had in mind because he had just returned from a

visit to Slimbridge in Gloucestershire, where Peter Scott and the staff of the Wildfowl Trust have developed a park containing the biggest and best collection of waterfowl in the world, beside a sanctuary on the River Severn where a great assembly of White-fronted Geese gather every winter. Fred immediately called a meeting of naturalists, hunters and wildlife biologists to discuss the proposal. Early in 1961 this group formed the British Columbia Waterfowl Society.

The directors of the Society agreed that their first objective should be to create a refuge that, like Slimbridge, would not only secure a significant area of marsh, but also offer opportunities for the observation, study and enjoyment of waterfowl, thereby capturing public interest and support. However, it was no simple task to select an area accessible to large numbers of visitors, suitable for a waterfowl collection, and close to a large tidal marsh favoured by birds—especially the Snow Geese—that could be declared a refuge without offending local waterfowl hunters. We made a survey of possible sites in the area of Vancouver and narrowed the choice down to four—Pitt River Valley, Mud Bay, Tsawwassen Bay and Reifel Island. Dr. G. V. T. Matthews, Director of Research at Slimbridge, visiting us in July 1962, confirmed our impression that Reifel Island, at the centre of the Delta, was the best from every point of view. By our second stroke of luck the owner, George Reifel, welcomed the opportunity to fulfill the dream of his father to turn part of his island home into a sanctuary. He generously agreed to lease 16 hectares of foreshore land to the Society for 30 years at $1 per annum. Beyond the sea dyke lay extensive tidal marshes which were Provincial Crown Land. In 1963 the Society succeeded in persuading the government of British Columbia to declare 280 hectares of these marshes a Provincial Waterfowl Refuge. Later the federal government also made it a Migratory Bird Sanctuary.

The area thus secured is bounded to the west by the 24-kilometre-wide Strait of Georgia, running between the Mainland and Vancouver Island. There the low tide exposes great sand flats, a feeding area for thousands of shorebirds and a resting place for ducks and geese. To the north in the Fraser Estuary are sea birds and diving ducks: scoters, Oldsquaws, scaups and goldeneyes. The edge of the marsh is a maze of hummocks and clumps of bulrushes on whose rhizomes and shoots the Snow Geese feed. The sedges fringing the broad tidal creeks provide additional food for the thousands of dabbling ducks which loaf there between their daily flights to the farmland. Further inland the sea-marsh becomes a thick jungle of cat-tails tangled with immense quantities of driftwood, and provides habitat for American Bittern, rails, Ring-necked Pheasants and songbirds. Behind the sea dyke of Reifel Island are meadows divided by broad drainage ditches and three large tidal creeks. The latter have now been blocked at both ends to form lakes, 800 metres long and 40–60 metres wide, which are resting

areas for large flocks of Mallards and about 2,000 American Wigeon which graze on the meadows in winter. The shallow waters of the island are almost choked with beds of sago pondweed, a food especially attractive to diving ducks. The hedges and coppices on the island add yet further to the variety of its habitats. As a result the sanctuary attracts more kinds of birds than most such areas on the coast; 135 species were recorded on one Christmas count.

No sooner was the sanctuary established than it proved its worth. Two thousand Taverner's Canada Geese which previously visited only for a few weeks in October, remained on the refuge until snow deprived them of grazing in January. Since then smaller flocks have visited each winter resting on the sand flats and flying into the meadows daily until hard weather drives them south.

At first we were less successful in attracting the Lesser Snow Geese into the sanctuary for long periods. The area of their favoured intertidal marshes within the angle formed by the west boundaries at first proved too narrow to give them a sense of security. However, in the early 1970s they began to make more use of the refuge and now have become as permanent a part of the winter scene as the White-fronted Geese are at Slimbridge. The percentage of the Delta's waterfowl wintering in the sanctuary was estimated to have risen from 4.2 in 1966-7 to 30.5 in 1968-9 (Hoos and Packman, 1974).

The spectacle of thousands of ducks and geese moving to and fro across the tidal marshes against a background of snow-capped mountains was sufficient to justify the Society's hope of making the refuge a public attraction. But confronted with the task of designing the waterfowl park, I regretted that I had not noted the details of construction and layout when I had helped to conduct visitors around Slimbridge ten years before. Fortunately the Canadian Wildlife Service decided to send me to Europe in 1964 to study the problem of reducing the hazard of bird strikes to aircraft of the Royal Canadian Air Force based in

Germany and France. In the course of this work it was necessary to consult leading experts on bird migration, including Dr. Geoffrey Matthews. He was at Slimbridge, so I had the opportunity needed to examine the layout and functioning of the Wildfowl Trust grounds with its collection, and to seek expert advice from the Director, Sir Peter Scott, and the Curator, Tommy Johnstone.

With plans completed we were still confronted with the problem of raising funds for their fulfillment. The first major contributions came from Vancouver businessmen. Then, in 1965, Ducks Unlimited selected habitat improvement on Reifel Island as its first project in British Columbia, making available a grant of $10,000 and the engineering advice of Gunnar Campbell. The Canadian Wildlife Service immediately added $35,000. This made it possible to build a dyke approximately 1,500 metres long enclosing part of the inner cat-tail-clogged tidal marsh, which could be cleared and converted into brackish marsh for feeding and nesting with controlled water levels. Even while bulldozers were still at work, waders, especially Greater Yellowlegs and dowitchers, thronged the shores of the new ponds and waterways. Smartweed and barnyard grass grew with amazing rapidity on the freshly dug soil and attracted large flocks of Pintails, Mallards, Green-winged Teal and American Wigeon within a few weeks. Sago Pondweed spread into the larger ponds and provided food for a flock of 200 Canvasbacks.

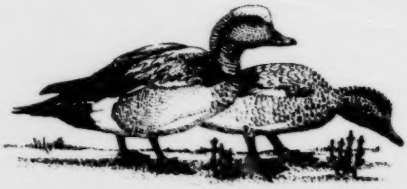
The habitat improvements also had marked effects on the species breeding in the refuge. By the spring of 1967 the numbers of nesting Blue-winged Teal and Cinnamon Teal had at least quadrupled. Mallard and Gadwall had increased too, seeking nesting sites in the newly dyked brackish marsh together with American Bitterns and Virginia Rails. It was also encouraging to see that Wood Ducks were making use of several of the nesting boxes put up in the waterside alder and poplars. Unfortunately breeding results were disappointing because many pairs were evicted by pugnacious European Starlings. Nevertheless, the number of waterfowl nests in the sanctuary increased from 18 in 1967 to 112 in 1970 (B. Davies, pers. comm. in 1971).

Once the refuge had a permanent staff it was possible to assemble a waterfowl collection. This started modestly with some Canada Geese and Mallard from Stanley Park. But it soon grew with the donation of Trumpeter and Whistling Swans; Ross', Snow (including Blue), White-fronted, Cackling and Dusky Canada Geese; all the dabbling ducks of British Columbia, plus some Black Duck from Ontario; Redhead, Canvasback, Scaup, Common Goldeneye, Bufflehead and Ruddy Ducks. At the end of 1969 the collection totalled some 700 wildfowl of 36 species. They lived within a fenced area of approximately 16 hectares, divided into pens of varying sizes. Fences were only one metre high, but to keep predators out, especially raccoons, foxes and mink, an

electric cattle wire was placed a few centimetres from the top of the perimeter fence and electrified at night. A raised, gravelled circuit enabled visitors to see the collection, and to view the marshes from two observation towers and a nature house. The sanctuary soon attracted an increasing flood of visitors from Vancouver and beyond. In 1973, for example, they totalled 59,000 (LeFevre, 1973; Hoos and Packman, 1974; Ward, 1980).

Wild shorebirds and waterfowl also flocked in to join those in the pens. Since many offspring of ducks and geese which nest in the pens are left free to fly, it is now difficult to tell resident birds from visitors. Some, of course, are distinguished by their rarity. In March 1969 a pair of Trumpeter Swans flew into Ewen Slough beside the pen where a pair of pinioned Trumpeters were calling. They remained for a few weeks, feeding in the slough and flying out to the sea marshes for grit. We wondered if they might stay and nest, but in April they resumed their journey to breeding haunts elsewhere.

The spring of 1974 brought another rarity, a little black and white member of merganser family called a Smew. An adult male had been seen for the first time in British Columbia in 1970 on Lost Lagoon in Stanley Park. Another Smew was seen at Reifel Island in 1975. The Northern Waterthrush seen in April of 1970 near Fuller's Slough at Reifel Island was also a new record for the Vancouver area. But the most exciting visitor for most naturalists was the red-legged wader reported in September 1970 among the Long-billed Dowitchers in the main pen. It was not until a month later that it was definitely identified as a Spotted Redshank, a species never before recorded in Canada. Birdwatchers from as far away as Texas rushed to the refuge to see this rare visitor. Strangely enough, the only other place at which I ever saw Spotted Redshanks was Elmer's End sewage farm, only 13 kilometres from the centre of London, when I first began birdwatching in 1946. There were five of them in company with a flock of Black-tailed Godwits. I suppose the sighting of one of these birds at the refuge should have given me a sense of "full-circle". But it didn't, because by then I had realized that Reifel Island was not an end, but only a beginning to the exciting work to be done in the field of waterfowl conservation in the Fraser Delta.



17. Serpentine Fen—A Wild Oasis

There is nobility about the old Fen. Nobleness of wide skies, of magnificent sunsets, of tremendous cloudscapes. You can see for miles; smell a wind as vigorous as a sea wind.

J. Wentworth Day, 1948

At first sight Serpentine Fen did not seem a very suitable place for a wildlife sanctuary. A triangle of flat, neglected farmland with a couple of derelict barns, it was crossed by a double row of power cables on conspicuous metal pylons, and was hemmed in on two sides by heavily used highways. Its area was little more than 80 hectares. Yet it caught my eye because it had a marshy and wild look about it. Driving past it daily, I seldom failed to catch a glimpse of a hawk or a Short-eared Owl quartering the wide expanse of ungrazed grass, or a pair of teal dropping into a sheltered little pool between thick clumps of rushes.

The real potential of the place only became clear on a bright, sunny March morning in 1964 when, with my family, I walked along the dyke of the Serpentine River which formed the north boundary of the old farm. Heavy rains had left wide patches of water in the neglected meadows, and as we drew near large flocks of Pintail, American Wigeon, and Mallard rose from the edges of these shallow pools and swung off towards Mud Bay a couple of kilometres down river. There were at least 2,000 ducks where usually the well-drained grassland would attract only Townsend's voles and the Marsh Hawks and Short-

eared Owls that preyed on them. The whole area lay below the high-tide level, but normally it drained at ebb tide when the rain water flowed to a big pipe in the river dyke and pushed open the metal flap-gate as the salt water in the estuary outside receded. On this occasion a combination of spring tides and heavy rain had created a temporary marsh which reminded me of the Welney Marshes in the Ouse Washes of eastern England. These washes are wide, flat grasslands between the Old and New Bedford Rivers that drain the fenlands. Each winter they are deliberately flooded to take pressure off the river dykes. Later, when I considered the dark, peaty soil, the open patches of marsh, the soggy areas of tussocky sedge and rush, and the brown stained water in the ditches, it was again to the fens that my memory turned.

Extending across East Anglia from Cambridgeshire to Lincolnshire, the fens won a romantic place in both the human and the natural history of England. From Roman times farmers fought a battle to drain them, and when at last in the seventeenth century they began to succeed, the fenmen or "stilt-walkers" who lived by fowling, fishing, eel trapping, and cutting peat and reeds, formed gangs to wreck the dykes, burn the windmills, and murder the hated Dutch engineers brought in to supervise the drainage. Inevitably the farmers won and the greatest marshes in England were lost with their myriad hosts of wildfowl and teeming shoals of fish. Only in Wicken Fen, restored to a flooded wilderness by the National Trust, can some of the former richness of the plant and animal life of the fens be seen today (National Trust, 1950; Wentworth-Day, 1954). Would it be possible, I wondered, to restore a remnant of the wild marshes of the Clover Valley here on this tiny patch of land between two highways and the Serpentine River? It was not this hope, but the dictionary which settled the name. A fen, it stated, is: "Low peaty land covered wholly or partly with water unless artificially drained." The description fitted exactly, so it became Serpentine Fen, a name which helped to distinguish this area from Serpentine Flats a few kilometres upstream.

Once my interest in the Fen was aroused, I began to visit it more frequently. The big flocks of ducks soon departed, but small groups of migrants continued to drop in. Dowitchers, Common Snipe, Western Sandpipers, Dunlins, yellowlegs, Green-winged Teal and Pintail shared one pool with a lone Cackling Canada Goose. By the end of April it was difficult to be sure which of the voyagers were moving on and which were taking up residence for the summer. The Red-winged Blackbirds and Killdeer plovers made their proprietory interest obvious by flying around and clamouring at intruders. But what about the Shovelers sifting through the muddy shallows and the Wilson's Phalaropes which followed them and daintily picked tiny creatures from the swirling water? They stayed through May and into June, but I could find no nests. By June there were ample signs of other breeding

birds. Blue-winged and Cinnamon Teal drakes chased after ducks hurtling low across the marsh in spectacular nuptial flights that ended in a flurry of splashing on one of the small pools. Mallard drakes gathered in groups while their ducks were conspicuously absent brooding their big clutches in well concealed nests. Anxiously scolding red-wings balanced on swaying stems with beaks full of insects. Savannah Sparrows flitted up from tiny cups in the grass containing four or five finely mottled eggs. A nervous Spotted Sandpiper ran and bobbed along a pool's edged with its gleaming brown eyes ever watchful. In June and July, half-submerged ducks led scuttling broods into the rushes and cat-tails. Tiny, fluffy Killdeer chicks ran into the weedy verges of the gravel road through the marsh, while a frantic parent fluttered ahead feigning injury. Short-eared Owls hunted through all but the noon hours to keep their voracious owlets constantly supplied with plump voles. Marsh Hawks from the peat bog further east also steered their easy, buoyant flight across the Fen, swerving suddenly earthward at the glimpse of prey. A Red-tailed Hawk from the nest in a maple on the ridge sat on a fence post intently watching the maze of vole runs and tunnels in the surrounding grass.

Of course, none of this was unique. The same birds and mammals could be found in dozens of places across the Fraser Valley. But few places brought them all together within the confines of such a small acreage. The Fen did so because it combined several different habitats. The grassland, neglected and unmown, supported an unusually high population of voles. This made it attractive to predators from weasels to coyotes and from American Kestrels to Great Horned Owls. The Serpentine River estuary was a rich habitat changing with each tide and season. There were some thick hedgerows and Pacific Crabapple trees to attract song birds. The marshes, though very small, were of three distinct types: tidal salt marsh, fen and fresh-water marsh.

The salt marsh was in a loop in the Serpentine River's tidal reach. When the dyke broke there years ago it did not seem worth repairing, so a new dyke was put across the base of the oxbow and the land within it was abandoned to the tides. As a result it became a little salt marsh which was attractive to waterfowl and shorebirds and offered open water when the fresh water marshes froze. The fen was also caused by a break in the dyke. As the water rushed through the breach it dug out a depression which became a shallow, peaty slough, fed by the rainfall and surrounded by a dozen hectares of tussocky grass and rush. The fresh marsh contained a series of small ponds fed by an artesian well. In winter the ponds covered less than two hectares and by the end of summer the area of open water shrank to less than half that size. Nevertheless, Blue-winged, Cinnamon and Green-winged Teal, Mallard and Pintail all nested there. The Pintails were especially unexpected because this duck is not a common breeder in the Fraser Valley.

The locals referred to the area as the "Ben Stevenson farm", but its lank, uncropped meadows and collapsing buildings made it obvious that it was no longer being farmed. A few enquiries revealed that it had been purchased by the provincial Department of Highways when the new highway had cut across it. This department had no plans for its use and welcomed the suggestion that it might be transferred to the Department of Recreation and Conservation.

Later that summer Ducks Unlimited sent engineer Gunnar Campbell to survey the projects at Reifel Island. Gunner is a quiet man with a friendly grin and a quick eye for "duck country". Once the job at Reifel Island was done, he willingly dragged his instruments off to any part of the Fraser Valley which might prove suitable for a "D.U." project. In a most energetic few days he surveyed several of the estuarine lands of the Fraser, some of the Pitt River marsh, and even found time for the rather small and unimpressive patch of grassland at Serpentine Fen. Fortunately the presence of the nesting ducks on the small fresh marsh served to demonstrate how productive the Fen might be if we could keep more of it flooded in the spring and summer by blocking the drainage system.

Unfortunately, there were snags. Several small properties on the southeast side of the Fen drained through it so the part of the Fen crossed by the main drainage ditch would have to be dyked and left dry in order to ensure that these properties were still drained. Furthermore, the central part of the Fen proved to be very peaty. Attempts to blow small ponds in it with explosives had limited success because the water seeped through the peat, into the ditches, and away with the low tide. This seepage was aided by a hidden system of drain pipes made of cedar planks which the marsh farmers had dug into the fields years ago. Even when the planks had rotted away, the tunnels remained,

often cleared and enlarged by muskrats. As soon as the rains stopped the watertable in the Fen dropped by a metre. These complications discouraged major projects, and for several years the Fen was used as a public shooting area. But its limited size and restricted water areas did not offer much sport and, by 1971, it had become obvious that it would serve a wider public if it was developed as an environmental study area, as part of a broad plan for public recreation and conservation embracing the whole coastal area from Mud Bay to the Fen. At the same time, Ducks Unlimited agreed to develop the Fen as a centre for the Fraser Valley Canada Goose Propagation Project. This involved enclosing about 30 hectares within a clay-cored dyke to contain a marsh fed by water from the Serpentine River. About a third of the new marsh was fenced to provide a pen for a pinioned flock of Canada Geese. Since this project had considerable educational value, the Principal and Council of Douglas College agreed to allow the Institute of Environmental Studies to operate an environmental study centre there and to hire John Smith and, later, Brian Lukyn, as wardens to help with the daily tasks of tending the pinioned flocks of 233 breeding geese provided by the B.C. Waterfowl Society and the Niska Waterfowl Park in Ontario. The co-operative aspect of the project was further extended when the Pitt Waterfowl Management Association and the B.C. Wildlife Federation provided some young Wood Ducks and Gadwall. The Canadian Wildlife Service donated grain for the flocks of captive waterfowl and the growing numbers of young geese and wild waterfowl which flew in and out of the pens. Federal Local Initiative Programs and provincial summer employment schemes made it possible to fence further pens, renovate the barns, make ponds, dam ditches, plant trees and shrubs, cut and store 4,000 bales of hay each year, and fence some of the meadows for a herd of Highland cattle (the remnants of Bruce McLean's herd from Campbell River Farm). Secondary School students in New Westminster prefabricated the study centre building which was put up on the site of the old Stevenson farmhouse.

The Canada Geese were released in the main pen by the Honourable Jack Radford, then Minister of Recreation and Conservation, in September 1973. These were "pinioned" by amputation of the terminal segment of the wing on which all 10 primary feathers are located. I wondered if over a hundred pairs of flightless geese were not too many for the 12 hectares within the pen, which were still bare and denuded of nesting cover. But Tom Sterling of Ducks Unlimited got help from the provincial Fish and Wildlife Branch and constructed dozens of big shallow cedar boxes, filled them with straw and set them out on the banks of the maze of ponds he had laid out in the pen when digging clay for the perimeter dykes. By April the flock divided into pairs which, with surprisingly little quarreling in so confined a space, began to appropriate the boxes. In May 50 geese were sitting on eggs, most of them in boxes, and two on the remnants of the hay piled at each end of

the pen. Most of the broods hatched well with an average of five goslings per nest. Now we realized that 250 hungry goslings would soon eat the pen bare of grass, so we hurriedly fenced most of the remainder of the dyked marsh which contained some broad areas of grassland. There were also several ponds thickly edged with rushes, which we hoped would give the goslings protection from predation. Nevertheless, mink, striped skunks, Glaucous-winged Gulls and Great Horned Owls, preyed upon them throughout the summer so that by the time the goslings could fly their number was reduced to 150. However, this rate of attrition was not excessive in an area visited by so many predators.

Unfortunately, many goslings exposed themselves both to predation and to wet weather by gathering in large numbers with a few dominant parents. It was not unusual to see one pair of adults accompanied by "gang broods" of 20–30 goslings, while the bereft parents accepted their loss and ceased to play a protective role. On the other hand, the dominant pairs were quite unable to protect all the goslings adequately. In heavy rain the strongest had the benefit of shelter under the goose's wings, but the weaker ones engaged in a constant struggle to find shelter under one another. The weakest died of exposure and exhaustion or were easily picked off by predators. From this we learnt to segregate family groups as much as possible in order to keep the goslings with their parents longer.

Once the young geese could fly the predators ceased to bother them. They joined the one-year-old geese which had been brought from the refuge at Reifel Island as goslings and released the previous summer on the Fen. These birds had conspicuous yellow neck bands, so when they ranged far and wide across the valley we had reports of their movements (See Chapter 20). Because they had learnt to fly from the Fen, they regarded it as home and returned from time to time, especially in winter when they discovered that the pinioned flock was receiving a daily ration of grain.

The Wood Ducks also established themselves in the same way. When the 10 pairs of young birds were delivered from Richard Trethewey's game farm they had the flight feathers of one wing clipped. We kept them through the winter in a covered pen with a small pond fed by a trickling artesian well. Towards the end of February we pulled out the stumps of the shortened quills and placed the birds on a bigger pond with thick reedy cover in a large open pen. Here they could grow their new flight feathers and begin to embark on flights to the other ponds and marshes where we had put up nest boxes in the hope of enticing them to breed. At least four pairs responded; two in boxes in the release pen, one in a box beside the main gate to the farmyard, and one in a box on a rafter in the big barn, which was put up when the duck was seen to show great liking for perching in the barn

and returned there day after day. One duck hatched 13 ducklings, another seven, and two more five. These families were seen from time to time in different parts of the Fen. As predators took their toll their numbers dropped, but there were always a dozen Wood Ducks on the pond in the release pen throughout the winter. Reinforced by a further 20 young birds in the second season, they have now established themselves on the Fen and have spread to more suitable wooded habitat up the Serpentine and Nicomekl Rivers.

The creation of new ponds and marshes resulted in an immediate increase in the numbers of wild waterbirds nesting in the Fen. Broods of Mallard appeared everywhere, even in the release pen. The Blue-winged Teal, Cinnamon Teal and Green-winged Teal remained on the ponds throughout the summer until their young could fly. Shovelers and Wilson's Phalaropes also nested, but were very secretive with their young. Common Snipe were present throughout the year, but I neither heard one "drumming", nor found a nest. Spotted Sandpipers nested, and I am sure both Virginia Rails and Soras did also for they were always present in certain localities. The Black Terns and Yellow-headed Blackbirds which appeared in the spring of 1974 were just visitors exploring the new marsh. When the waters grow richer in plant and animal life they too may become summer residents.

As autumn approached shorebirds came into the Fen as never before. The flashing flocks of Western Sandpipers and Sanderlings, followed later by Dunlins, were accompanied by small groups of less common species including Baird's Sandpiper, Pectoral Sandpiper, Least Sandpiper and Semipalmated Plover. Standing out among the "peeps" were plump dowitchers, Greater and Lesser Yellowlegs, or, rarely, small numbers of Whimbrels, Hudsonian Godwits, Willets, and Solitary Sandpipers.

All this was exciting. But for me the most rewarding result of our work was the arrival of the wild geese. Even from a distance it could be seen that the newcomers in October were obviously smaller than the geese we had released on the Fen, but larger than Cackling Canada Geese. They were evidently Taverner's Canada Geese. It was easy to locate them because they were accompanied by three Lesser Snow Geese. These birds stayed around the Fen until the first snowfall.

During the second winter there were no Snow Geese, but instead three White-fronted Geese arrived. They were all adult birds and were beautifully marked with bold, irregular bands of black on their light undersides. When the dozen Taverner's Canada Geese which accompanied them moved on, the three White-fronts remained and became quite tame, especially when they saw the grain bucket. They departed in April, closely followed by a solitary little Cackling Canada Goose which had dropped in on the spring migration.

During the third winter the numbers of wild geese increased. Early in October about 200 Taverner's Canada Geese and 22 White-fronted Geese arrived. The White-fronts kept to themselves, but the Taverner's Canada Geese mixed freely with the flocks of local geese. However, every evening they became uneasy and after periods of calling and wing-flapping they rose together and flew out to the sandbars in Mud Bay. Unfortunately, with the opening of the hunting season and the presence of gunners near their roost, most of the wild geese including all the White-fronts disappeared. Presumably they moved on southward to the refuges of Oregon and California. A few Taverner's Canada Geese appeared from time to time throughout the winter, and in December two little Cackling Canada Geese dropped in. One was very much larger than the other, and was darker with a very sooty breast. In February three White-fronted Geese also returned and as spring advanced more joined them until there were eleven. Three of them remained on the Fen until May 7.

Of course the increase in the marsh and grazing meadows for waterfowl was made at the expense of the rough grassland. The flooding reduced the habitat of the Townsend's vole which was reflected in a drop in numbers of Short-eared Owls nesting on the Fen. But the other predators retained their place in the cycle of the seasons. Once renovations were complete, Barn Owls returned to the big barn and on many winter nights a Great Horned Owl sat on the end of the broad shake roof watching for rats. Two Snowy Owls spent the winter of 1973-74 on the Fen. The evidence of their pellets and dramatic imprints and bloodstains in the snow revealed that they often preyed on ducks—Mallard, American Wigeon and Pintail, and once on a hen Ring-necked Pheasant. In February I saw a cock pheasant stooped at by a magnificent grey Gyrfalcon. The victim hurled himself earthwards with such force that he bounced on landing, but quickly recovered and

scuttled under a barbed wire fence, where he crowed angrily at his assailant. The falcon hovered over him for a moment but was frustrated by the wire and flew up onto an arm of a nearby pylon while the pheasant dashed down the line of the fence and made good his escape into a thick clump of crabapple and bramble.

The Gyrfalcon does not seem out of place on the Fen in mid-winter, but I was surprised to see one stoop lazily at three passing Mallards on a sunny afternoon in August. As it drew closer I could see why it had not made a serious pursuit—its crop was bulging with pickings of a recent kill. Hardly had this visitor from the Arctic disappeared, when a rare visitor from the warm south came into view, the graceful form of a Great Egret. Although common in its normal range, this bird is rare as far north as British Columbia and has been seen in the province only three or four times. I was glad to know that when such wanderers come this way they find places like Serpentine Fen awaiting them.

Peregrine Falcons and American Kestrels are also occasional visitors to the Fen, but the most frequent of the falcons is the Merlin, especially in the fall. The Cooper's Hawk is a daily visitor from the wooded ridges to the north and south, and a Sharp-shinned Hawk flashing through a gap in the hedge is not an unusual sight. I have seen an immature Goshawk a few miles away on Boundary Bay but so far none has been recorded on the Fen.

Marsh Hawks and Red-tailed Hawks are always present, and in winter they are joined by the big, hovering Rough-legged Hawks. During a period of gale-force winds, one of these birds broke a wing on the power line, but in the skilled care of the staff at Reifel Island the wing was reset and after a few weeks of convalescence the big hawk was released in time to join the spring migration back to the Arctic tundra. Common Ravens, Turkey Vultures and Bald Eagles sometimes come to the Fen and occasionally Ospreys join the other fishers of the estuary—the herons, loons, grebes, cormorants and mergansers. As the river waters carry more fish into the Fen the numbers of all these birds will certainly increase there.

Of course there are many who fail to see these things. To them the Fen is a wasteland. Their attitude is understandable. Three or four generations of farmers have fought against floods and tides, marsh and scrub to create farmland. To allow even a derelict and abandoned patch of 80 hectares to revert back to something like its original state is to them a retrograde step. But if we relate this area to the vast acreage of similar land and water which we have radically changed and ruthlessly exploited, it does not seem much to ask that it remain as a testimony of the landcape and wildlife which was sacrificed to our needs.

As an environmental study area it displays to us and to our children something of a landscape that is now almost forgotten. If it demonstrates the prodigious efforts of our pioneering forefathers in conquering that landscape, it also gives thought for the future. It forces us to ask what sort of a valley we hope to live in tomorrow. Do we want to keep a place for the circling hawk, for the dainty flocks of Dunlins, or for the cry of the wild geese? If so, how can we do it?

The Fen poses such questions. It also offers some answers.

18. Mud Bay—Estuary of the Twin Rivers

. . . wildest of all are the saltings and mudflats of the coast. Here the sky is master of the scene; the grandeur of sunrise and sunset is reflected in the tidal pools and, dully, on the surface of the wet mud. The creeks wind sluggishly from the marshes towards the open sea, and at flood tide sea itself comes wandering back. At spring tides it whispers through the grass and washes against the sea walls. In this world live the wildfowl . . .

Peter Scott, *Wild Chorus*, 1939

Two kilometres downsteam from the Fen the Serpentine River flows into Mud Bay. Beyond the confines of the dykes it crosses three kilometres of open sand and swings southeastward to meet the tidal reach of the Nicomekl, which enters the bay two kilometres further to the south. The shallow estuaries and shoals of the two rivers embrace most of Mud Bay. Each rising tide overwhelms the rivers' muddy flow and spreads their silt across the sand to form a marsh of green hummocks and soft ooze which gives the bay its name.

The flowing tide quickly turns even the smallest gutters into sticky obstacles and makes Mud Bay a difficult place to explore on foot. A few punt gunners know it well. Outside the hunting season the creatures

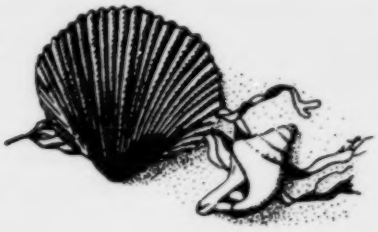
that live there are seldom disturbed. A herd of hair seals hauls out on the sandy shore of the Serpentine estuary and the females give birth to their silvery-grey pups in the maze of islands and hummocks near the Nicomekl's mouth.

Because the flow of the two rivers is small compared with that of the tides, the water is more salty than on the Fraser Delta, so the marshes are different. Cat-tails, bulrushes and sedges are replaced by Pacific glasswort, sea-blite, sea plantain, arrow-grass and saltgrass. Glasswort, salicornia, or marsh samphire, was known to the settlers as pickle-weed because its fleshy, gerkin-like fingers are edible. The islands and hummocks of Mud Bay are covered in it and are therefore teeming with tiny crabs and sandhoppers which find cover in the thick, matted growth. As a result the islands are important to waterfowl and shorebirds, not only for the cover they offer but as a source of food.

Beyond the tidal marshes lie the flats which extend across the estuaries of the Nicomekl and Serpentine Rivers and join those of Semiahmoo and Boundary Bays. The three bays contain over 7,000 hectares of sand, silt, mica, shell and organic material. Out on the vastness of this open landscape it is difficult to believe that you are only a few miles from a major city. The sea-ribbed sands seem empty, but little holes and mounds, like miniature volcanoes, are reminders of the life beneath the surface where hosts of crustaceans, shellfish and other marine animals live out their lives geared to the cycle of the tides.

The tidal flats also support two inconspicuous but important plant communities. Between the salt marsh and the low-tide line the surface supports a band of algae. The growth of small varieties turns the flats green in summer. Larger species such as sea-lettuces are washed on to the flats from the gravel beaches where they grow attached to rocks and stones. This algal band supports a large variety of small marine animals which are eaten by shorebirds and waterfowl, especially Green-winged Teal. Other waterfowl also eat the plants, especially sea-lettuce which is taken by Brant. However, as described earlier the main food of this little sea-goose is eel-grass, two species of which grow on the lowest parts of the flats, exposed only at low-tide. Its beds form the basis of the other major plant and animal community of the tidal flats. Each eel-grass plant has three to six dark green leaves which can grow over three metres long. Fish, molluscs, crustaceans and other marine animals live in the shelter of their extended blades. Herring lay their eggs on them. So, although they occupy only a small portion of the flats, the eel-grass beds add enormously to the productivity of the shallow tidal bays, making them areas of great economic importance to man as sources of food for salmon and other fish.

Great Blue Herons know the riches of the tidelines too. Dozens follow the retreating waters and hunt the shallow pools for stranded fish and crabs. In the evening as they fly to their roosts in tall Douglas-firs along the shore their place on the sands is taken by gulls which come there to pass the night.



Sometimes migrating Taverner's Canada Geese stop on the sand flats. Early in October 1963, a week before the hunting season opened, I spent a Saturday in a punt in the tidal channels and gutters of Mud Bay. In the late afternoon the geese arrived from the Arctic. As they approached the bay high over the ridges of Surrey, the purposeful beat of their wings seemed to falter here and there. There was an outburst of chatter, then a silence as all wings set and they began to glide down. Suddenly in a wild clamour of voices the ordered skeins broke into a chaos of excited birds falling and tumbling like autumn leaves on the wind. Tipping first one way and then the other to spill the air from beneath their pinions, the geese hurtled downwards. Just above the sands they levelled out with lowered feet, and with a few measured flaps braked their flight and alighted, as daintily as a lady from a carriage, 400 metres from the channel which hid my punt.

For half an hour they kept coming in skeins ranging from a few dozen to 200 birds until finally over 2,000 geese were standing on the sands before me. Cautiously peering over the rim of the channel, I expected that after such a long flight from the north they would immediately settle into sleep. But instead they drank and bathed in the puddles left by the retreating sea. They flapped, splashed and chased one another from favoured pools like school children on a sea-side outing. There was an enchanting exuberance in their behaviour which was fascinating to watch. But after a couple of hours the clamour and movement gradually subsided as one by one they folded their necks and lifted one leg into the warmth of their breast feathers or crouched upon the sand to rest. But even when the whole flock was still and silent, one or two wary heads were raised in turn to maintain a constant watch. It was only with the greatest care that I was able to paddle back along the channel without disturbing them.

When the tide rises on rough, windy days the marsh in Mud Bay becomes a mecca for ducks and shorebirds. Then close-packed flocks of "peeps" and other shorebirds—Western Sandpipers, Least Sandpipers, Sanderlings and Dunlins—sweep and turn across the sands, flutter in between the hummocks and crouch among the Green-winged Teal feeding along the creeks. The larger shorebirds shelter in the glasswort. These include Greater and Lesser Yellowlegs, Black-bellied Plovers, Whimbrels, and dowitchers. Occasional visitors and rarities like Long-billed Curlews, Wandering Tattlers, Pectoral Sandpipers, Solitary Sandpipers, and Marbled Godwits, may also be among them. There are few better places to see these birds than on the islands of Mud Bay or on the large marsh jutting into the sea where Mud Bay meets Boundary Bay. These few hundred hectares of vegetation offer more cover from the elements than all the thousands of hectares of open sand. Yet when the tide recedes the restless birds are off again, twisting and turning above the sands, their white underparts flashing in the morning light, looking like a "handful o' shillings flung on the wind" as the old fowlers used to say.

Wherever wildfowl and shorebirds congregate, predators will not be hard to find. In the fall the swift-winged Merlin dashes low across the sea-grass into a flock of sandpipers on the shore. The Peale's Peregrine Falcon, the dark-plumaged subspecies of the Pacific Coast, hunts regularly here. I have seen one swoop at a wigeon from above, sweep downwards past its prey, and then hurtle upwards on the impetus of the dive to seize the unfortunate duck from below. Bald Eagles scan the shore for wounded birds lost by the hunters and out on the open bay they harass diving ducks repeatedly until they can clutch the bird from the water too exhausted to dive again.

The richness and variety of the marine and shore life in Mud Bay has convinced many people that Mud Bay should be a sanctuary, closed to all disturbance and viewed from the beach and nature park at Blackie Spit at the mouth of the Nicomekl and from some observation points on the eastern shore. The need for such sanctuaries has grown with the increase in public demands for a greater share of the shoreline for recreation. Not only hunters, but also boaters, hikers, birdwatchers, beachcombers, dune-buggy drivers and a host of other recreational users will exert heavier pressures on the tidal shores in the coming years. The combination of the marina in the Nicomekl estuary, a beach and nature park at Blackie Spit, a sanctuary in Mud Bay and a public shooting area north of the Serpentine estuary would serve the varied public needs in the area, and at the same time ensure that provision is made for the waterfowl, shorebirds and other marine life traditionally associated with Mud Bay.

The idea of a sanctuary in Mud Bay is not new. Canon Martin Holdom and Millar Lougheed, residents of Crescent Beach, suggested

it in the 1950s (Millar Lougheed, pers. comm. in 1978). A decade later Bill Morris of the Canadian Wildlife Service proposed two refuges, one of 160 hectares at Grauer Beach in Boundary Bay and another of 600 hectares in Mud Bay (Morris, 1965; Morris, 1971; Hoos and Packman, 1974). Together they totalled less than 20 per cent of the area open to hunting in Boundary and Mud Bays. Compared with the ratios between hunting and closed areas on other managed wetlands in the United States and Canada, this did not seem an excessive sacrifice for hunters to make for better quality sport and the maintenance of wintering waterfowl numbers. Today we must ask ourselves if wintering Brant would have abandoned Boundary Bay if such a plan had been adopted.

Five years later Robert Wenman, a member of the Provincial Legislative Assembly, drew up a private member's bill for a "sanctuary area for the purposes of the protection or conservation of wildlife" at the confluence of the Nicomekl and Serpentine Rivers, but like Bill Morris he was surprised to find that his proposal was rejected by the very people in the government departments from whom he had expected the most support. To make matters worse a plan for a large marina on the most southerly part of Mud Bay was approved by the Municipality of Surrey in 1972. It was averted only after reports from the Institute of Environmental Studies, Douglas College, had drawn the attention of government environmental agencies and of the public to the unsuitability of the site for such a project (Institute of Environmental Studies, 1972, 1973, 1973a; Leach and Maynard, 1972). Finally, to prevent a revival of such plans, the Nature Conservancy of Canada and the National Second Century Fund contributed funds towards the purchase of the privately owned 58 hectares in the bay by the then British Columbia Department of Recreation and Conservation. Even then controversy about its use was not over (Leach, 1976; MacDonald, 1976; Institute of Environmental Studies, 1975, 1976, 1977). In contradiction of the aims and wishes of the two contributing agencies, the provincial Fish and Wildlife Branch recommended that the purchase should be designated a public shooting area. It was only after considerable discussion that the small 58-hectare parcel was made a sanctuary. But it was too small to be effective when the remainder of the 600 hectares of tidal marsh and flats remained a public shooting area. Yet in the course of the Ocean Shorezone Study conducted in 1978 by the municipal planning department in co-operation with citizens groups and other government departments, local opinion was strongly in favour of declaring the whole of Mud Bay an ecological reserve or sanctuary (Surrey Planning Department, 1978).

If eventually such wishes are fulfilled and Mud Bay at last becomes a sanctuary, the benefits will be limited neither to the people of Crescent Beach nor to the creatures which live and die in the bay. For the

ecological values of this estuarine marsh reach out much further than its geographical bounds. They extend beyond Boundary Bay and Point Roberts into the deeper waters where the herring, bred on the eel-grass and fed in the coastal shallows, are in turn devoured by the salmon. The values of Mud Bay are carried, too, on the wings of the Pintail, Wigeon and Mallard as they fly from their roosts and loafing places, up the Clover Valley and across the Fraser to the marshes gleaming between the forested slopes of the Pitt Valley. Here ducks feed until the movements of the sun, moon and tide draw them back to the sea once more. As they return their long weaving threads across the sky remind us that they are part of an indivisible system, and that the places they join by their flightlines are not just worth preserving for their own sake but also for their part in the patterns of life and movement across the delta.

19. The Valley of Swaneset

Swaneset, whom the Lord Above created . . . accomplished even greater miracles than the other leaders of his generation. . . . Satisfied with his work, he returned to his people at Sheridan Hill and announced that he had reshaped the land so that it would provide them with an abundance of Indian potatoes, cranberries, and other foods.

The Katzie Book of Genesis
Diamond Jenness, 1955

We need the tonic of wildness—to wade sometimes in marshes where the bittern and meadow-hen lurk, and hear the booming of the snipe, to smell the whispering sedge where only some wilder and more solitary fowl builds her nest, and the mink crawls with its belly close to the ground.

Thoreau, 1854

The Indians called the Pitt River *Skaycaya'i Stalo*, the River of the Katzie. To them it was a place of riches created by Swaneset, the "Supernatural Benefactor". Its bogs were heavy with berries, and in some of the marshes the Wapato, or Indian potato, grew in such profusion that people came from the villages along the Fraser and even

from Vancouver Island to share its harvest. The White Sturgeon swam up the Pitt River to spawn in its tributaries. Seals also came upstream to Pitt Lake. In the fall waterfowl filled the marshes, especially the big Wapato marsh south of the lake, called *Scaca'ican*, a place of geese and swans. The marsh was dangerous to hunt on foot due to its deep potholes (Suttles, 1955).

According to Katzie legend, a supernatural being named Khaals found two sisters dancing and laughing as they dug Wapato in the Pitt Valley. Because they mocked him, Khaals transformed them into Sandhill Cranes, evermore to roam the marshy meadows and to dance and laugh as they root up the Wapato as they did as girls.

In the spring the Sandhill Cranes returned. Simon Pierre of the Katzie Indians who was born about 1880 recalled his father Old Pierre describing the arrival of the cranes in thousands. Whether in thousands or in hundreds, as seems more likely, these birds made a deep impression upon the Katzie people. To them March was "the month of the cranes", and the birds were respected as the guardian spirit *syhaha'w*, meaning "superior in everything", that gave skills to women in their work (Jenness, 1955).

In 1860 the Governor of British Columbia, James Douglas, travelled up the Pitt River to assess the valley's agricultural possibilities. He found its banks "exceedingly beautiful". "Extensive meadows", he noted "sweep gracefully from the very edge of the river towards the distant line of forest and mountain . . . The rich alluvial soil produces a thick growth of grass and scattered groups of willows." However because much of it was exposed to "the periodical inundation of the Fraser," the Pitt Meadows were not suitable for grain crops but "may be turned to good account in growing hay and every kind of root crop, and . . . for pasturing cattle and for the purpose of dairy." He estimated that 20,000 acres of good arable land, ". . . requiring no clearing from timber, . . . (were) ready for the immediate operations of the plough" (Pitt Waterfowl Management Association, 1972).

The new Governor's optimism was not justified and several decades passed before his assessment was even partially fulfilled. The river itself is scarcely more than 20 kilometres long, but between its beginning at the southwest corner of Pitt Lake, and its meeting with the Fraser eight kilometres east of New Westminster, it is joined by the waters of Silver Creek, Widgeon Slough, Sturgeon Slough, the North and South Alouette Rivers, Blaney Creek, De Boville Slough, and numerous small streams fed by the heavy rains on the vast watershed of the Coast Range which towers above three sides of the valley. So steeply do the mountains rise from the valley floor that the peak of the Golden Ears, 1,800 metres above Pitt Lake, is only a little over three kilometres on the map from its shore. The lake, formerly a fiord,

reaches 33 kilometres back into the mountains, and the streams that feed it extend from Mount Garibaldi another 30 kilometres to the north. Furthermore, the many waters which converge upon this small valley are met here daily by the rising tides and, through June, by the swollen flow of the Fraser in full flood. In winter when the forested walls of the valley rise into the rainy mists, the floodplain has a wild and sombre look. The sedges of the marshes and the leafless trees in the swamps seem dark and dun against the steely-grey waters. The bogs become quagmires and the dank forests drip on to a saturated floor of moss and decaying vegetation. In summer the Pitt Valley becomes a place of wild flowers and bird song against a backdrop of snowy peaks, but it is still a place of shining waters.

Discouraged by the high and fluctuating flood levels, the pioneers settled on the higher ground at Maple Ridge, but later homesteaders spread westward into Pitt Meadows along the Fraser and on the lower reaches of the Pitt River. A few ventured north of the Alouette or on to Douglas Island or Surrey Bend, the broad apron of swamp, bog and marsh formed by sediments at the confluence of the Fraser and the Pitt. But they did so only in the summer, after the Fraser had subsided, to cut wild hay or graze cattle.

By the first decade of the twentieth century most of the Lower Mainland had been settled, so attention focussed on the few remaining unclaimed tracts. In 1911, 2,720 hectares in the Pitt Marshes were purchased and the new owner began the construction of dykes in the hope of draining the land for agriculture. After 20 years of expensive failure, attempts at cultivation were abandoned and the land reverted to marsh (British Columbia, 1976). But in 1951 the Dutch arrived.

Water is an old enemy of the Dutch. Few people in the modern world have fought it longer or with more skill. Their Pitt Polder Company purchased the marshes in 1951 and successfully undertook the task of transforming 1,700 hectares north of Sturgeon Slough into dairy farms. But even the Dutch were discouraged from further expansion northward by the costs of competing with the constant flows of tide and flood in an area of poor soil leached of its minerals and made acidic by its load of organic sediments.

So, over 1,200 hectares of marsh and bog remained between the polder farms and Pitt Lake, matched across the river by the marshes and swamps of Siwash Island, Widgeon Creek, and the broad triangle of marsh and sedge meadow between Burke Mountain and the river dyke. Coast black-tailed deer, black bear and cougar continued to descend into these lowlands from the mountains. Bald Eagles and Ospreys still carried fish from the lake and waterways back to their eyries in the bare tops of old Douglas-firs on the forested slopes. A few Sandhill Cranes lingered on each summer secretly tending their gold-

brown chicks until they too could take flight over the bogs and bushy swamps that had hidden them in their helplessness.

Even in their most successful breeding year the Sandhill Cranes seldom totalled more than a score in the entire Lower Mainland. They are long-lived birds, but their reproductive capacity is low. They do not commence breeding until at least two years of age, and sometimes defer it until their fifth year. They lay two eggs but usually raise only one of their offspring. Thus, even under favourable conditions, they recover slowly from reductions in population (Walkinsaw, 1973; Miller, 1974; Howard, 1976).

Unfortunately, conditions were not very favourable. Many of the former haunts of the Sandhill Crane in other parts of the Fraser Valley were converted into berry farms, mined for their peat, filled with dredgings or garbage. The draining of surrounding lands resulted in a drop in the water table in the remaining bogs and the growth of birch and pine over large areas formerly inhabited by the crane. While such losses of habitat were evidently important factors in the crane's decline, it was significant that its numbers continued to dwindle even in the two remaining large areas of its habitat: Burns Bog, encompassing over 4,000 hectares of bog and open peat cuttings, and the Pitt Valley bogs and marshes, totalling about 2,000 hectares. Both areas were bordered by extensive open farmlands which provided feeding opportunities. However, the Sandhill Crane proved very sensitive to disturbance. In its summer habitat it required three separate territories for nesting, roosting and feeding. Habitat changes or disturbance on any of these interrupted its breeding cycle and caused desertion of the nest or of the

entire area. Even in the wide expanses of Burns Bog in the delta, regular peat cutting by hand on comparatively limited areas apparently upset the cranes, and the mechanization of this industry may have contributed to the decline in the number of nesting birds in the last 30 years.

By the mid-1970s the cranes of the Pitt Marshes were the last remnant of the nesting population in the Lower Mainland (Robinson, 1974; Leach, 1980), and, paradoxically, the very vegetation that protected them from human curiosity and disturbance was gradually swallowing up the marshes and berry bogs in which they lived. For the ecological systems of the Pitt Marshes were changing. Although the dykes and ditches north of the polder had not effectively drained the marshes, they did encourage succession in the vegetation from marsh, meadow and berry communities to bog and shrub communities of lower nutritive value to animal life. The landscape now contained fewer open areas of marsh attractive to water birds.

Nevertheless, large parts of the valley on both sides of the Pitt River were leased by exclusive gun clubs which helped to maintain wildlife populations by controlling access and by limiting the number of days hunted by their small memberships each season. Some of their preserves were so little hunted that they were virtually sanctuaries. But the presence of such clubs was resented by other hunters. The establishment of a 240-hectare Public Shooting Area south of Pitt Lake in 1958 did little to reduce the criticisms because it was usually empty of ducks compared with the neighbouring private marshes.

The increasing demand for outdoor recreation near Greater Vancouver added to the popular feeling that more of the Pitt Marshes should be obtained for public use or for conservation and in 1974 the provincial Greenbelt Protection Fund purchased 1,170 hectares north of Pitt Polder. A year later, management authority for the area was transferred to the provincial Fish and Wildlife Branch which had already begun to study the problem of restoring the marshes. Ducks Unlimited undertook to finance a project to redirect the run-off from the polder farmland in the hope that it would add much needed nutrients to the marshes and help to maintain stable water levels and better conditions for nesting and wintering waterfowl.

This project aroused strong protest from the local naturalists who believed that the construction work and the resulting habitat changes would have adverse effects upon the few remaining pairs of Sandhill Cranes nesting in the valley. A study of the situation by Thomas J. Howard, an expert on the Sandhill Crane from the University of Wisconsin, did little to resolve the problem. He confirmed that breeding cranes need isolation from human disturbance and also open marshland. Unfortunately the creation of the latter would also destroy

the cover that afforded the cranes isolation and protection from view. His statement that the tiny remnant population of 20 birds ". . . is barely capable of maintaining itself" encouraged those who believed that the marsh improvement plan should not be impeded for the sake of a few cranes which were doomed to extinction anyway (Howard, 1976).

As if to speed up the cranes' demise, the construction of a power transmission line across the greenbelt was carried out in the spring and summer of 1976. The arrival of the birds was closely followed by that of helicopters bringing in pylons. However, the cranes shifted away from the noise and activity and succeeded in raising a few young.

In the spring of 1977 construction of marsh compartments began and continued throughout the rest of the year. Only three pairs of cranes nested, their efforts apparently unsuccessful because no young birds were observed in the late summer. It was the worst year the Sandhill Cranes had ever had in the lower Fraser Valley.

There was also dismay among naturalists when the Fish and Wildlife Branch released a plan to extend the public shooting area across the heart of Pitt Marsh by the construction of a system of boardwalks and shooting blinds, many of them close to crane nesting habitat. Furthermore this plan, geared mainly to the production and exploitation of wildlife primarily for hunting, revealed an unrealistic appreciation of public expectations of wildlife management in the Lower Mainland in the 1970s. It was disappointing that the unique opportunity to begin a program of wildlife recovery and enhancement was only partially recognized, especially when there was an urgent need for undisturbed loafing habitat for the local Canada Goose population that was expanding rapidly as a result of the propagation program started a few years earlier. Finally as a concession to its critics the branch closed the open, empty expanse of the old Public Shooting Area to hunting. To many this seemed but a hollow gesture, for as long as the heartland of the valley is open to hunting the true potential of the Pitt Marshes as a haven for the larger waterfowl, the geese and swans, will never be known.

The disappointment felt by naturalists was increased by the knowledge that the stated primary aim of the Pitt Wildlife Management Area is "to provide for the conservation needs of wildlife." But before those needs were even defined and the means of providing for them tested, priority shifted to the secondary aim of providing for the public ". . . as extensive and varied a recreational and educational experience as possible." As a result, instead of becoming a place where the needs of wildlife come first, the Pitt W. M. A. became more like a combination between an unmanaged park and a public shooting area. The uncontrolled access contrasted sadly with the carefully designed systems of

screened approaches to enclosed observation blinds and towers at wildlife management areas of comparable size for shy waterbirds in other parts of the world.

The critics of this view accuse conservationists of neglecting the recreational needs of people. But in the Fraser Valley we are already well provided with opportunities for hiking, canoeing, hunting, fishing, and, indeed, for all the forms of outdoor recreation that are being unnecessarily and unreasonably imposed upon this last breeding area of Sandhill Cranes in the Lower Mainland. If properly managed with suitably varied degrees of human access and use, wildlife management areas often prove to be among the places most highly valued by people because the very restraint in their use revives the quality of their wildlife populations for the enjoyment of the visitors.

Depressed by these events, in the fall of 1977 I went to see Colonel Clarence Wallace, former Lieutenant Governor of British Columbia, and owner of 280 hectares of marsh on the west bank of the Pitt River at Addington Point. To my joy he agreed to sell his marsh at a very reasonable price to the National Second Century Fund. In the fall of 1980 Addington Point Marsh became a provincial wildlife sanctuary. So perhaps, at least on the west bank of the Pitt River, we shall be able to emulate, on a minor scale, the success of the Americans in reviving the return of wintering geese and swans in the National Wildlife Refuges of the Willamette Valley. By a strange coincidence the Katzie Indians knew this marsh by the similar sounding name, *Wi'llamnats*.

Meanwhile, what of the Sandhill Cranes? By 1979, perhaps only three pairs continued to nest in the valley. Their continued presence was felt to be due rather to their longevity than to their annual recruitment. In short, their final disappearance seemed inevitable. So the Pitt Wildlife Management Area Public Advisory Committee decided to set up a sub-committee to seek ways of restoring the population. The first priority was the protection of habitat. Little more could be done in the Pitt Valley, but efforts were made to prevent the further destruction of Burns Bog. The second priority was to follow the example of the Whooping Crane restoration program and to reinforce the declining numbers of Sandhill Cranes with young birds raised in captivity. We hoped that the birds introduced from the marshy meadows of Idaho would extend the breeding territories of the cranes beyond the bogs and into the marshes on both sides of the Pitt River. There was also a good chance that hand-reared birds would show greater toleration of people on or near their habitat. Of course there is a danger that such birds may become "imprinted" upon their human foster parents or fail to migrate with the wild flock and so remain dependent upon humans for the rest of their lives. But in order to migrate the hand-reared birds would have to be introduced while there are still wild birds to lead

them to their unknown wintering grounds. So time was running out and, in spite of the uncertainties, the decision was made to go ahead.

Both federal and provincial government agencies provided permits and funding to hire staff and buy equipment and food. Volunteers from the Pitt Waterfowl Management Association, the Institute of Environmental Studies, the Federation of B.C. Naturalists and the B.C. Wildlife Federation also gave assistance. Above all Richard Trethewey provided a home base for the project at Conigas Ranch at the south end of the Pitt Valley, and gave unstintingly of his time in day-to-day supervision of the project.

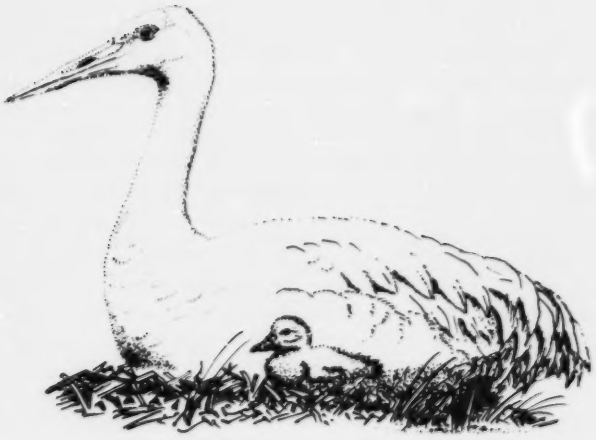
With the help of Rod Drewian of the U.S. Fish and Wildlife Service we collected 30 eggs from nests in the marshy valleys of southern Idaho near Grays Lake National Wildlife Refuge. From the sage-covered hillsides it was possible to spot the hummock-like nests of the great birds in the expanses of sedge and rush. When approached the parent bird stretched out her neck close to the water, then took off, flopping about in a pathetic simulation of injury. Thirty eggs were collected in Idaho, and one in the Pitt Valley. Of these 26 hatched. Injury and sickness took its toll, and as I write 17 of the twelve-week old chicks have survived. The full story of this project must be told elsewhere.

Of course we are dogged with the question "why bother?" Sandhill Cranes exist in large numbers, not only in Idaho, but in other refuges and wild areas of North America. Why should we make a special effort to maintain them here?

There are many answers, but none very satisfactory to persons who feel no sense of wonder at the sight or sound of these great birds with their bugling call, and who feel no sense of remorse that a species that has survived on earth for nine million years is disappearing from this valley after a little more than a century of the white man's presence. But to anyone who cares about the natural world upon which we have superimposed the structures and systems of the human environment, the Sandhill Crane is a precious remnant of something elemental.

The bird itself is special. Its size, its call, its very wildness, capture the imagination. To retain it close to a major portion of the human population of the province would be to extend the possibility of an exciting experience to a large number of people who would otherwise never chance upon the sight or sound of a crane in its natural habitat. Furthermore, if we do not make the effort to preserve here this remnant of a species that is still under pressure in many other parts of its range in British Columbia, when then do we begin?

To the Stalo people, who were here before us, the Sandhill Crane was a guardian spirit. In a larger sense it is still the guardian spirit of the places in which it lives. The pioneers found a wild landscape here; a few remnants of it remain in Burns Bog and in the Pitt Valley. Perhaps the test of our ability to retain such remnants of the natural landscape in the Fraser Valley lies in our ability to restore their guardian spirit—the Sandhill Crane.



20. A Helping Hand

. . . raising waterfowl poses scientific challenges. The simple wonder of a boy watching a brood of downy young develop into flying adults may initiate a lifetime study . . . Whoever keeps waterfowl finds his environment enriched in beauty and vital activity.

Peter Ward, 1973

In the past the main reason for the propagation of waterfowl in captivity has been to supplement or create a huntable population. More recently propagation under artificial conditions in zoos, sanctuaries, and research centres has helped to reinforce the remnants of endangered populations of birds. Propagated waterfowl are also released in gardens and parks for aesthetic reasons. In sanctuaries they may be both ornamental and educational. They give visitors a close look at the native species and act as decoys to attract their wild counterparts within easy distance for viewing and photographing. The fact that there is creative pleasure in aviculture is also important. Enthusiasts who started with a couple of ducks or geese in a backyard pen have been responsible for helping to restore endangered species like the Ne-ne Goose of Hawaii in their native range.

The creation of new landscapes by human action, as in the Fraser Delta, encourages the introduction of alien species of wildlife. The Ring-necked Pheasant is an obvious and successful example. There are justifiable objections if the introduction of aliens leads to competition or hybridization with native species. However when these dangers are

avoided the propagation and release of waterfowl is a useful means of restoring populations lost through habitat changes or over-shooting, or of compensating for the adverse effects of environmental changes. Populations of birds established by propagation and release are described as "feral". The dictionary defines this word as: "wild, not tame . . . having become wild again after taming or domestication", but it is often misunderstood as meaning "semi-tame", so some prefer to describe the Canada Geese introduced into the Lower Mainland as the "local" population rather than the feral population.

Several species of waterfowl breeding in the Lower Mainland owe their present status and distribution in the past to the helping hand they have received from humans. The Mallard has benefitted greatly from the habitat and feral stocks provided in parks. The Gadwall, Shoveler and Pintail, which only bred in a few isolated localities, were reinforced by introductions at the sanctuaries at Reifel Island and Serpentine Fen. As already described, the Wood Duck has been the subject of a propagation program lasting several years.

Four species not previously known to nest here have also been established. One, the American Wigeon, still confines its breeding to Reifel Island where it was first released. Even if it spreads as a nesting bird its presence would not be a biological abnormality. This species nests mainly in the Arctic and on the prairies, but there are also considerable breeding populations in the interior grasslands of British Columbia and southward as far as California. A few American Wigeon are regularly seen throughout the summer here.

The same cannot be said of the Black Duck which is a bird of the eastern forests and coasts of North America. Birds released here breed with Mallards and produce "dirty-looking-Mallard" hybrids which have neither biological validity nor aesthetic appeal to justify their presence on the Pacific Flyway.

The establishment of a free-flying breeding population of Lesser Snow Geese at Reifel Island has also been criticized because the introduced birds are from a more easterly Arctic breeding population than the snow Geese that winter on the foreshore of the sanctuary. The latter come here from Siberia and perhaps Alaska. The introduced bird may carry genes which result in the occurrence of "Blue Geese", or Lesser Snow Geese with partially blue-grey plumage. However different these birds may appear from the white geese, they are the same subspecies or race. The blue-phase geese, as they are called, occur more frequently in the eastern breeding and wintering grounds of North America, but they seem to be spreading westward into the Central Flyway. During the spring migration Snow Geese from the Central and Pacific Flyways use the same staging areas; so a further natural, westward spread of "Blue Geese" is possible. In March 1970, 50

blue-phase geese were observed flying with a large flock of Snow Geese over Sturgeon Bank. The feral flock of Snow Geese at Reifel Island do not therefore seem to pose a biological threat through an abnormal mixture of breeding populations. Furthermore the aesthetic, recreational and educational values of the free-flying flock are also considerable factors in their favour. The sanctuary at Reifel Island is associated with the Snow Geese, and the presence of these birds for the public to observe and enjoy at all phases of their life cycle is undoubtedly one of the attractions of the place.

The case of the local Canada Geese is more complex. These are birds of mixed origins, predominantly Great Basin Canada Geese from the interior with some Vancouver Canada Geese from the northern coasts of the islands and mainland. Neither subspecies has ever been recorded nesting in the lower Fraser Valley, but both may occur as winter visitors or transients. The first introductions were made into Stanley Park in the mid-1940s. In the 1960s the number of geese in the park reached about 200 and goslings were transferred to other locations in order to ensure that the resident population did not exceed what the available grazing could support. Some of these birds were released at Burnaby Lake and at Deer Lake Park.

In 1967, 24 Canada Geese, mostly from Stanley Park, were released at the George C. Reifel Migratory Bird Sanctuary. At the same time nine Vancouver Canada Geese were also placed in the pen area there, but in the following years they bred with the feral geese from the park and no pure stock of this subspecies was maintained. Fifteen years later the flock of free-flying, feral Canada Geese at Reifel Island numbered over 300. The establishment by the Canadian Wildlife Service of the Alaksen Wildlife Management Area on about 228 hectares of land adjoining the sanctuary on Reifel and Westham Islands provided an increase in the grazing and nesting habitat available for the geese on public lands. Nevertheless, neighbouring farmers were concerned at the crop damage allegedly done by the geese and the British Columbia Waterfowl Society was therefore not averse to the idea of restricting the size of the resident flock by transferring goslings to other locations.

Thus the initial spread of Canada Geese from Stanley Park and later from Reifel Island was a response to local pressures and not part of a plan to establish the bird as a resident breeding species throughout the Lower Mainland. However, by 1970 the feral goose population in Vancouver, Burnaby and Delta had increased sufficiently to encourage a more methodical approach. Furthermore, it was by then too large to leave much freedom of choice in the selection of the subspecies to be propagated. The feral geese were thriving and available, and the Pitt Waterfowl Management Association intervened to place their further expansion on a more organized footing.

In 1971 the Association transferred 53 young Canada Geese from Stanley Park and released them in the Pitt Meadows area. They were banded with numbered, green plastic neck collars so that their movements could be traced. Few of the green-collared birds survived the following hunting season, and this release was considered unsuccessful.

Nevertheless, in 1972, 274 adult Canada Geese were transferred from the Reifel Sanctuary and Coniagas Farm, the base of the Pitt Waterfowl Management Association, to various locations on the Fraser River near Fort Langley and on the Pitt River and its marshes. As already described, the most significant release took place at Serpentine Fen in Surrey which became a major production area for the program.

The Canada Goose project was arranged with the co-operation of government agencies, Ducks Unlimited, the B.C. Wildlife Federation, the B.C. Waterfowl Society and the Pitt Waterfowl Management Association. However there was no clear agreement between the participants about the aims of the project, and in August 1973 a meeting of the B.C. Waterfowl Technical Committee, comprising representatives of the Canadian Wildlife Service, the B.C. Fish and Wildlife Branch and Ducks Unlimited, recommended the formation of a co-ordinating advisory committee. Estimates predicted the fall population of local Canada Geese at approximately 2,500 birds in three years, 8,300 in six years and 20,000 in 12 years. A harvest of 2,380 birds could be permitted in the sixth year when hunting reopened and of 5,800 in the twelfth year.*

* These and other statistics on this subject are taken from the reports distributed to the Fraser Valley Canada Goose Propagation Programme Advisory Committee.

Many naturalists in the Lower Mainland were critical of this propagation project because, as usual, a great deal of the time and resources of the government wildlife agencies would go into a program designed primarily to benefit hunters. Furthermore, it would strengthen the local populations of a bird that had probably never nested wild in the lower Fraser Valley. However some hoped that numbers of Canada Geese on the new sanctuaries and lure-crop areas, included as part of the program, would encourage a return of the migratory Taverner's Canada Geese, and perhaps even White-fronted Geese and Whistling Swans, to the Lower Mainland. The marsh habitat improvement work of Ducks Unlimited would also benefit other native waterbirds.

Reaction from some farmers was unfavourable from the start. They expressed their opposition to introducing geese into agricultural areas to the Minister of Recreation and Conservation when he visited Serpentine Fen in September 1973.

In 1975, the number of goslings hatched was increased by "double-clutching". The first clutches of about half the goose nests at Reifel Island, Serpentine Fen and Coniagas Ranch were removed and hatched in incubators, leaving the geese to lay and hatch a second clutch. The result was that 249 goslings were numbered with leg bands and yellow collars and released at various sites between the delta and Hope.

On February 13, 1976, naturalists and hunters counted 1,783 Canada Geese throughout the lower Fraser Valley. Of these 125 had collars, but the numbers could be read on only 83. Apparently about 2,000 local Canada Geese were present in the Valley, accompanied by about 2,000 migrant wintering Canada Geese. The sightings also revealed a considerable wandering and mixing. Birds released at Serpentine Fen and at Burns Bog were seen at Stanley Park and Reifel Island. Others from Burns Bog were identified at Bristol Island near Hope. Reports of collared birds were received from Washington and Oregon.

In 1976 "double clutching" resulted in 464 goslings at Serpentine Fen. However, due to rusting at the base of the pen fence, an unknown number escaped to the river and so in late June and early July only 404 flightless juveniles were released in the central and easterly part of the lower Fraser Valley, in the Pitt Valley, and in the Sunshine Valley a few miles west of Manning Park.

Observation of the release sites several weeks later confirmed that the geese remained in areas where good grazing was available beside water bodies large enough to give security from predators, especially coyotes. At release sites on the Fraser River the birds were usually carried off by the swift current and dispersed before they could fly.

This led to the establishment of breeding populations in several downstream urban and industrial areas along the river, especially between Coquitlam and Burnaby where flocks of up to 50 geese loafed on log-booms and flew from the river to graze on sports fields and parks in New Westminster and in neighbouring suburban areas. Lacking suitable nesting sites, these geese often began laying on the piles of wood-chips loaded on scows awaiting departure to the pulp mills. In 1976 several pairs of geese nested and successfully raised their broods along the river dykes below the Port Mann Bridge.

A census of Canada Geese in the lower Fraser Valley on September 18, 1976, revealed that the local goose population was between 3,500 and 4,000 birds. After a subsequent count, on January 15, 1977, the estimate was that 5,600 Canada Geese were present. Since the maximum number of local birds was unlikely to be over 3,500, the remaining 2,100 were probably migratory geese attracted into the valley by the local birds and by the five-year moratorium on goose hunting.

These estimates suggested that the program had achieved the aim of its supporters among the naturalists who had viewed it mainly as a means of demonstrating the need for a system of sanctuaries to attract and support a wintering population of Canada Geese that was not a burden to the farmers. Since the establishment of free-flying flocks in 1974, the program was obviously going to be at least partially successful, the growing flocks of resident and wintering geese would need secure areas for their daily life cycles, commensurate in size with their numbers. But, in spite of the assurance by the program management committee in 1973 that ". . . sanctuaries, public shooting areas and lure crop areas will be designated before the reopening of the hunting season," no lands were made available for these purposes beyond those already designated as sanctuaries and management areas at Serpentine Fen and Reifel Island. Proposals for the addition of the publicly-owned greenbelt near Mud Bay to the Serpentine Wildlife Management Area were strongly opposed by the farming community, and the idea of a loafing sanctuary in Mud Bay was rejected by the Fish and Wildlife Branch. Then, at the very moment it was needed, the Fish and Wildlife Branch was given a greenbelt comprising almost 1,200 hectares of marshy land in the Pitt Valley to manage for public recreation. This seemed to be a unique opportunity to provide a haven, not only for the feral Canada Geese when the moratorium on goose shooting ended, but also for the other migratory waterbirds depleted in recent decades. Instead, in 1976, the branch produced a plan to convert the best marsh habitat in the greenbelt into a public shooting area. Those participants in the Canada Goose Propagation Programme who had placed land management for waterfowl high on the list of benefits expected from it were bitterly disappointed (British Columbia, 1976).

Paradoxically, the need for adequate, secure habitat for the local Canada Goose population was strongly demonstrated at that time by critical reports in the local newspapers. The editorial of the *Surrey Leader* on September 18 was entitled, "Why Hatch a New Problem?" and complained that the establishment of a resident population of 20,000 Canada Geese in an area devoted to commercial vegetable production was ". . . just plain stupid". On May 8, 1976 the *Vancouver Sun* announced that, "Freeloading Geese get Farmers' Goat". The most serious complaints were from farmers close to the Reifel Sanctuary where pea crops and, later, barley, attracted flocks of up to 400 Canada Geese, and by August some 1,500 Mallard and Pintail. Fortunately, the provision of scaring devices and vigorous action by the staff of the Canadian Wildlife Service and the growing of lure crops at the Alaksen Wildlife Management Area helped to alleviate the problem, and above all showed the farmers that their concern was recognized. However, when representatives of the local agricultural organizations heard that one purpose of the Canada Goose program was to disperse the geese produced at the sanctuaries they remained skeptical on the grounds that this action had merely extended the problem to their members elsewhere.

In an effort to encourage the geese to remain in the small 80-hectare sanctuary at Serpentine Fen, the Fish and Wildlife Branch decided, in the spring of 1976, to abandon the cattle grazing operation which, as at the Ouse Washes in England and at the Vejlerne Marshes in Denmark, had proved its worth to water birds (Olney, 1969; Fog, 1976). Instead, a mechanized farm operation was adopted to convert several of the meadows to arable land for the production of grains. Although the new crops proved attractive to the geese during early growth and after cutting, the overall effect of the change was detrimental. The grass became overgrown in many areas and during the period between May and July the geese wandered more than ever. In 1978 cattle were returned to the Fen.

The Canada Goose program has brought back the sight and sound of Canada Geese to people along the lower Fraser (Grieshaber, 1977). It has also provided several useful lessons. It has demonstrated the need for better public information and closer liaison between wildlife managers and the various interest groups affected by such programs. It has given valuable practical experience in many aspects of land and water management and of animal husbandry. But it has also underlined the dangers of departing from the natural traditions of the past and of introducing a completely "man-made" population of feral birds. The problem of crop damage by Canada Geese in the spring and summer could have been avoided if, instead of propagating feral birds, funds and efforts had been devoted to obtaining and safeguarding undisturbed feeding and loafing habitats for the traditional *migratory*

populations of Canada Geese. Given such habitats, Taverner's Canada Geese and other field-feeding geese and swans may well return to the delta and floodplain of the Fraser as they have in recent years to the National Wildlife Refuges of the Willamette Valley in Oregon.

PART FOUR: WATERFOWL PROBLEMS

Other depressing effects upon waterfowl abundance are transitory compared to the long-lasting effect that habitat destruction and deterioration have upon their populations.

Glen C. Sanderson, 1976

21. Loss and Pollution of Habitat

. . . coastal salt marshes are among the most valuable and productive natural plant and animal communities on earth . . . The higher the price of marshlands goes, the more likely they are to be turned to profit and destroyed. The more marsh is destroyed, the less desirable the shore front for the things which made the marsh high priced in the beginning. The end result will be the seaside slum which is becoming commonplace . . . The only absolutely irrevocable loss is the marsh itself.

A. L. Hawks, 1966

The biggest threat to waterfowl in the lower Fraser Valley is loss of habitat. Over a million people, more than half the population of British Columbia, live in Greater Vancouver and make an essential contribution to the industry, commerce and agriculture of the province. Half of the area occupied by industry has direct access to water on 45 kilometres of shoreline, and all but 16 per cent use it. There are four major harbours and numerous small boat docks. Almost an entire deltaic island is occupied by the Vancouver International Airport (Romaine *et al.*, 1976). The construction of 530 kilometres of dykes has converted 70,000 hectares of former marsh and floodplain into drained agricultural land (Seimens, 1968). All this is necessary to our way of life. It was not, however, necessary to spread urban development across the

rich deltaic soils of Lulu Island and Ladner. Fortunately the Agricultural Land Reserve has checked the sprawl in this direction, and provided an opportunity to examine the complex problems of maintaining viable agriculture and open space in a metropolitan area. Public concern for the land has been matched by concern for the shores. So today there is hope that, on farmlands and parks, sanctuaries and shooting areas, enough suitable habitat will be conserved in the lower Fraser Valley to maintain the surviving traditions of migratory waterfowl and perhaps even to revive some lost ones. Land designation is, however, still much too loose, and only when a firmer system of zoning is applied to shores and wetlands will the remaining waterfowl habitat be safe from destruction by commercial development.

Urban sprawl can be checked by wise land-use planning and zoning, but pollution is a more complex problem. Studies by the Westwater Research Centre at the University of British Columbia confirm that urban-industrial developments are major sources of pollution and that toxic wastes pose the greatest long-range threat of the ecological systems of the lower Fraser. Bacterial pollution makes the estuary unsuitable for water contact activities such as swimming, and it is now dangerous to eat shellfish from the shores of the Lower Mainland. Heavy metals such as mercury, lead, and cadmium have been found in higher quantities in crustaceans on Sturgeon Bank at the mouth of the Fraser River than in the less polluted parts of the coast (Dorcey, 1976). Diving ducks that feed on shellfish and crustaceans may be affected, but this problem has not yet been studied.

The use of the sewerage system for the disposal of toxic wastes greatly complicates the problem of pollution control in Greater Vancouver and poses a constant threat to wildlife. For example, the release of parathion into a sewer resulted in the discharge of the substance at Brockton Point on the shore of Stanley Park where it killed over 200 diving ducks that feed at the sewerage outfall, including scaups, goldeneyes, Oldsquaws and scoters (MacNeill and Barnard, 1978).

Incidents during the last five years have demonstrated the danger of insecticide poisoning to waterfowl feeding on agricultural lands. In one kill alone, 1,400 ducks were found dead. The victims are usually dabbling ducks. In the winter of 1975 over a thousand Green-winged Teal were killed in one field. Pintail, Mallard and American Wigeon also died of pesticide poisoning in Delta and on Lulu Island. In the worst cases the chemicals had been applied in excessive quantities. Carbofuran was responsible for three kills. This product had been used in other areas without ill-effects, but the acidic soil conditions in the Lower Mainland evidently inhibited decomposition of the chemical and caused the accumulation of lethal amounts. The manufacturers voluntarily removed it from their sales in British Columbia. Neverthe-

less, similar products remain on the market and, acccording to the agriculturalists, they are required to combat a wide range of insect pests which attack crops on the delta.

One of the most serious pollutants ingested by waterfowl is lead shot. Normally about 1,400 pellets may be scattered into the marshes for every duck bagged. On returning to feed, ducks mistake the expended shots for grit or seeds and eat them. They are ground in the gizzard and lead salts pass into the body tissues causing sickness, paralysis and death. Lead poisoning was recognized as a major cause of waterfowl mortality in 1874 (Bellrose, 1964; Bellrose, 1976; Bellrose and Sanderson, 1977).

J. A. Munro first reported the problem in the Fraser Valley in 1936, in a study of Mallard feeding habits. He recorded that 11 of 90 ducks examined contained lead shot in their gizzards. Subsequent studies have confirmed the seriousness of the problem in Mallards and Pintails (Pearson, 1969).

Percentage of birds examined containing ingested leadshot (Tener, 1948; Malysheff, 1951; Burgess, 1968; Pearson, 1969)

Date	*Reporter*	*Mallard*	*Pintail*	*Baldpate*	*Green-winged Teal*
1948	J. Tener	16.1%	5.0%	Nil	Nil
1951	A. Malysheff	16.0%	23.0%	Nil	—
1968	T. Burgess	11.2%	5.0%	1.0%	Nil
1969	A. Pearson	14.4%	10.5%	Nil	Nil

From January, 1964, to December, 1976, 62 of the 323 (19.2%) waterfowl examined for lead poisoning in the Animal Pathology Division of Agriculture Canada were confirmed as suffering from it (MacNeill and Barnard, 1978). This figure is, of course, high because only suspected cases were examined. The percentage of birds shot in the field must also be regarded as high because ducks sick from lead poisoning are believed to be twice as likely to fall to hunters' guns. However, if we take half of the average percentages above, about 7.2% of the Mallards and 5.4% of Pintails on the Lower Mainland have lead shot in their gizzards at any one time. At least half of these, or 3.6% and 2.7% respectively, will die of lead poisoning. This loss is high compared with the average across North America which is estimated at 2 or 3% of the fall waterfowl population.

The high incidence of lead poisoning in the Fraser delta may be attributed to the concentration in a limited area of a large number of hunters, an average of 15,000 during the 1950s and 1960s. In 1968, when they shot an estimated 178,000 waterfowl (Taylor, 1970), some

249,200,000 lead pellets were spread on the feeding and loafing areas of waterfowl. While the lead tends to sink out of reach in the organic ooze of the inland marshes it apparently remains accessible on the firmer soils of the delta and so accumulates from year to year.

The most extreme case of lead pollution was documented in 1972 when students conducted a count of lead pellets over part of the intertidal zone of Burrard Inlet near Pigeon Point where Band-tailed Pigeons were intensively hunted until 1970. The soil in the area consists of a thin layer of mud over non-porous clay. The 27 samples taken yielded an average of 86 pellets per square metre, a range of 28 to 148 pellets per square metre (French *et al.*, 1972).

Attempts to overcome this problem by replacing lead pellets with steel shot which does not poison waterfowl are being made in the United States (U.S. Dept. of Int., 1976). Although the loss of birds to lead poisoning is high, it is not conspicuous. The victims are usually caught by predators or scavengers when the toxic effects of the lead reduce their physical and mental powers.

The effect of oil pollution is much more visible, even when caused by relatively small spills. Waste oil discharged into Burnaby Lake in 1967, for instance, was drained from the engines of a few government trucks, yet it killed not only the family of Trumpeter Swans mentioned in an earlier chapter, but also Mallards, Gadwalls and Blue-winged Teal. In 1972 a release of rapeseed oil into the same lake again killed numbers of water birds, including dabbling ducks (MacNeill and Barnard, 1978). But these incidents are dwarfed by the immense danger of oil pollution at sea.

In April, 1972, a study carried out for Environment Canada stated that in view of the operating characteristics of tankers and the navigational problems of the study region, ". . . there is a 50% chance of an oil spill involving a supertanker occurring at least once every twenty years" (Paish, 1972). The report identified two principal hazard zones: the south shore of Vancouver Island and the Lower Mainland coast from Semiahmoo Bay to the Fraser delta. A scenario based upon a spill of 40,000 tons of crude oil at Alden Bank near Cherry Point, in typical weather and tidal conditions for the area, revealed that after 36 hours the slick, covering 14 square miles would have moved 18 miles northward to cover thousands of acres of intertidal zone in Boundary, Mud and Semiahmoo Bays. Ten miles of Boundary Bay shoreline would be coated with oil and the number of birds affected could be between 10,000 and 50,000, depending upon the time of the year. After two days the slick would extend over 35 square miles. The birds contaminated could then number 100,000. The approximate cost estimated for the clean-up was $24,363,000.

Three months later an oil spill actually occurred when a valve burst on a Liberian tanker unloading at Cherry Point. According to officials at the oil refinery, only about 20 barrels or 840 gallons escaped. Nevertheless, this was sufficient to demonstrate the accuracy of the scenario. Within 30 hours the slick was 14 miles long and had soiled 25 miles of shore in Washington and British Columbia. Semiahmoo Bay, Crescent Beach and Mud Bay were the areas worst affected. The emergency caught both the oil company and the Canadian authorities unprepared. Much of the clean-up was conducted by volunteer labour and improvised methods. Thousands of bales of hay were used to mop up the oil on the beaches. The spill occurred at a time when the bird population was at its lowest and only a few dozen birds were found oiled. But the headline in a local newspaper, "What could happen with a big one?", reflected public dismay at the lack of preparedness for such emergencies and at the dangers of increased tanker traffic to Cherry Point.

The hazard presented by small sources of oil pollution was also demonstrated five years later, in August 1977, when a pipe on an oil storage tank used for fueling fishing boats broke and spilled 25,000 gallons of oil into the harbour at Steveston. Part of the oil escaped on to Sturgeon Bank and some was carried right across the Strait of Georgia to Active Pass. Salmon fishing was banned in the strait until clean-up operations were completed. Propane exploders were used to scare birds off the polluted tidal marshes west of Steveston. Again, the losses suffered by birds were not high because the major concentrations of migratory species had not yet arrived.

Oil spills are the most spectacular demonstration of the temporary destruction of habitat by pollution. But the gradual reduction of habitat

by continual pollution resulting from industrial and commercial development is no less a threat to the wildlife of the shores and shallow waters. The development of a deep-sea harbour in Boundary Bay, for instance, would undoubtedly have been a disaster for the waterfowl of the Lower Mainland if it had been allowed to proceed. But although this project was averted, another threat remained in the form of pressure for more marinas in the estuary of the Nicomekl and on the shore of the Semiahmoo Bay. The tidal flows and the prevailing southerly winds tend to hold wastes in the bays and deposit them along the shores and beaches where fragile ecosystems and other recreational assets suffer. The amounts of gasoline and oil dripping from small boats and garbage jettisoned by their owners may not seem to amount to much, but over the years the accumulated effects can be disastrous to birds like sea-ducks, loons and grebes which are wholly dependent upon the natural productivity of shallow coastal waters for most of the year.

Such birds leave these waters only to nest. As soon as their young can fend for themselves they quit the forest lake or Arctic tarn and return to the coast. But they need a special kind of coast, one that is not too deep nor yet as shallow as the tidal flats, so that they can comfortably dive to a bottom rich in crustaceans and shellfish on which they depend for food.

There is no place on the Lower Mainland coast better suited to their needs than the shore between White Rock and Crescent Beach. Thousands of these birds, including scoters, scaups, mergansers, goldeneyes, Oldsquaws, Ruddy Ducks, Harlequin Ducks, Bufleheads, loons, grebes and cormorants are present there throughout the year. An increase in boat traffic will bring an increase in oil in the water, and even a small spot of oil on one of these birds will kill it by breaking the waterproofing and insulation systems provided by the bird's plumage and by permitting water to penetrate into the layer of warm down beneath. When this becomes waterlogged the bird will either drown or die of cold and starvation on the shore. The bodies of many that suffer this fate are already too frequent on the tideline.

The accumulative effects of marinas on shallow parts of the coast and estuaries eventually result in the destruction of the very features which attract people to the shores and waters. Large scale motorboating, marinas and marine gas stations would be better placed near the deeper waters of the delta, at places like Tsawwassen and Iona Island, where the flushing action of the Fraser or of the coastal currents disperse and absorb the ill-effects of pollution. However, it is difficult to convince the majority of boat owners that their activities are a threat to the natural life of the shores because pollution does not always have

immediate visible effects but works insidiously in ecosystems over long periods. Oiled birds succumb quickly, but others that ingest poisonous substances die only when they have accumulated lethal doses. Sometimes they do not succumb to the poison but, weakened by it, become vulnerable to disease or predation and so appear to die of "natural causes".

22. Disease and Predators—Enemies Inside and Out

Disease directly or indirectly accounts for the largest proportion of non-hunting deaths.

Frank C. Bellrose, 1976

. . . we have the familiar picture of man attempting to raise a population density by eliminating predators and finding himself bound to a policy of ever greater control—costly control, with the result in the long run, an unbalanced environment . . . Changes in the environment—increased cover, better food arrangement, secure travel lanes, better nest sites—can decrease the vulnerability of a desirable species to . . . raptors or mammalian predators.

John and Frank Craighead, 1969

Fortunately disease is not a major threat to waterfowl on the Fraser delta. The temperate climate, high rainfall and acidic soil of the Lower Mainland reduce the hazard of botulism that takes a heavy toll of ducks in warmer, alkaline marshes and lakes. However, studies by the Vancouver branch of the Animal Pathology Division, Agriculture Canada, indicate that "pollution of natural and managed waterfowl areas as well as unhealthful environments attributed to human activities directly

affect disease occurrence in waterfowl populations" (MacNeill and Barnard, 1978). Elsewhere duck plague (duck virus enteritis) and fowl cholera have spread from domestic poultry to parks and sanctuaries (Friend, 1976). So far the major problem here has been the occurrence of coccidiosis among captive waterfowl. This disease, as well as aspergillosis, another sickness that occurs in poultry, may be spread from penned or pinioned birds to the free-flying birds that visit their ponds.

Internal parasites, worms and flukes, occur in about half the free-flying waterfowl examined here. They are not normally the cause of death, but can debilitate birds weakened by disease, lead-poisoning, polluted food or malnutrition due to disturbance and night-feeding (MacNeill and Barnard, 1978).

Like diseases, injuries suffered by waterfowl are increased by human activities and man-made changes. Overhead cables and power lines are a danger to large, fast-flying species. Swans flying at 80 kilometres an hour have difficulty in changing course suddenly. Furthermore, the location of their eyes on the side of the head gives them a very wide visual scan but it limits the effectiveness of their forward vision and their ability to judge the distance and location of hazards in their flight path. A Whistling Swan found dead near Serpentine Fen broke its neck on striking a telephone cable with its open gape while calling in flight.

Cables are particularly hazardous when they cross rivers or other natural flight lines of waterbirds. The power cable across the Serpentine River and Fen has killed or maimed a wide range of species, including Mallard, Pintail, Common Merganser, Great Blue Heron, Pelagic Cormorant, Rough-legged Hawk, and, surprisingly, a Common Murre. Most of the victims struck the cable at night, in fog or in high winds. The power cable installed across the major flight lines in the Pitt Valley will undoubtedly prove to be a major hazard, especially to the cranes, geese and swans there.

Collisions with fast-moving vehicles on highways also takes a steady toll of waterfowl. The most common victims are Mallard which nest beside the broad ditches which parallel the highways in low-lying areas. It is not unusual for traffic accidents to occur when birds fly across highways, but a much greater problem is presented by the threat of bird strikes to aircraft. The location of Vancouver International Airport on Sea Island guarantees that bird strikes will be a chronic hazard, because the foreshore and open grasslands are attractive to the successive waves of migratory birds which arrive there. As a result the Canadian Wildlife Service has been forced into the paradoxical position of having to divert part of its limited resources from much-needed conservation programs to the reduction of bird populations on a major

part of the delta. This is perhaps the most extreme example of conflict between wildlife and technological man, when the very presence of birds is an anathema. Thus the failure of the Canadian Wildlife Service to express clear opposition to the reactivation of the airport on the shore of Boundary Bay came as a shock and disappointment to most conservationists in the Lower Mainland (Blokpoel, 1976; Federal Environmental Assessment Review Office, 1979).

Under natural conditions the raptors and mammalian predators constitute no threat to the transient and wintering population of waterfowl on the delta. Along the northwest coast of North America, the Bald Eagle is the main natural predator of waterfowl, especially diving ducks. The victim is relentlessly harried with flat swoops which force it to dive. Eventually the exhausted duck mistimes its re-appearance and is seized from the water and carried to a convenient perch to be partially plucked and devoured. Ducks and shorebirds are readily taken by Peale's Peregrine Falcons that wander along the Pacific shores from their eyries on the islands and mainland coasts between Oregon and the Kuriles (Brown and Amadon, 1968; Beebe, 1974). Continental Peregrine Falcons, the "Duck Hawks" of the east, nest between Vancouver Island and Hope. At two of the 10 known eyries the prey remnants were mostly European Starlings, but, like the Peale's Falcon, these swift predators undoubtedly prey on small waterfowl during their winter wanderings. Large ducks and even geese may be struck down by the big Gyrfalcons that come regularly to the delta from their Arctic breeding haunts. At Reifel Island I saw one of these falcons bring down a Mallard and then decapitate it on the ground. Cooper's Hawks and Goshawks may also kill a few waterfowl by taking them by surprise on the ground or in narrow ditches. The larger owls, the Great Horned and Snowy Owls, certainly take a toll of ducks in the fields by night and day. Predatory mammals such as the red fox, coyote, mink and weasels will also seize waterfowl by stealth in the twilight or darkness. But neither the predators of the night, nor the falcons and eagles by day inflict any abnormal loss or disturbance upon the wintering flocks from which they remove their prey. In the summer it is a different story.

European settlement in the lower Fraser Valley has resulted in a marked increase in garbage and its attendant rats and mice and this, in turn, has fostered increases in the numbers of scavengers and predators. These are a constant menace to the small summer population of waterfowl attempting to nest and raise young on the limited confines of the few remaining marshes and ponds. Northwestern Crows, Common Ravens, Glaucous-winged Gulls search out their eggs and seize their ducklings. The slower raptors—Marsh Hawks, Red-tailed Hawks and Short-eared Owls, that present little hazard to fully grown ducks, can become a menace to young broods, especially where grazing cattle have removed cover plants.

Predatory mammals are an even greater danger. The banks of ponds, streams and ditches are regularly searched by the red fox, coyote, mink, long-tailed weasel, striped and spotted skunks, raccoon, opossum, and Norway rats. Domestic dogs and cats may also prey on waterfowl nesting near their owners' homes. The threat of these animals is greatly increased by the reduced size of the habitats now available to waterfowl. In the absence of large fresh marshes or shallow lakes, many ducks attempt to rear broods on small ponds with inadequate plant cover or in agricultural ditches that are straight and devoid of protection from the swoop of a hawk or the pounce of a cat. The dyked banks, burned-off each spring to reduce weeds, and the scoured shores of the Lower Mainland's rivers offer little habitat suitable as "duck nurseries".

The answer to this problem should not be sought in the illegal and impractical waging of warfare with gun and trap upon every bird with talons and beast with fangs. It lies rather in the provision of water areas with sufficient protective cover to enable breeding waterfowl to employ their natural defences of concealment and evasion against predators. Private landowners, outdoor clubs, parks boards and other civic agencies with access to land should be constantly encouraged to restore productive pond and stream habitat. But it is difficult to win cooperation from the owners of the smaller wetlands of the Fraser Valley when the impact of human disturbance upon waterfowl on the wide tidal marshes and other publicly owned marshes is inadequately assessed or controlled.

23. Human Disturbance

. . . we have no reason to believe that geese fear death per se. We have ample reason to believe that geese fear us. Approach . . . geese in November, and they will retreat with the same zeal regardless of whether you want to shoot at them, take pictures of them, or simply look at them.

David Hatler, 1973

In studying the background of a waterfowl population which has been subject to man's influence over a long period it is desirable to consider not only the part man has played in re-shaping the environment but to consider also the current man-bird relationship.

J. A. Munro, 1957

The impact of human disturbance on birds has not been much studied. The reasons are obvious. It cannot be measured in hectares like habitat losses, nor in dead birds like pollution kills. It is evident that humans disturb wildlife, but there has not seemed to be much point in attempting formal observations of a process which varies so greatly with the circumstances. Furthermore, the most direct sources of disturbance are recreational activities like hunting and nature study, so there is an understandable reluctance on the part of scientists and

government agencies to undertake studies in a field with no easy means of measurement but plenty of controversy.

Yet the value of habitat preservation is much reduced if it is not matched by effective protection from disturbance. The reduction of wetlands makes it important to ensure that waterfowl are able to make the greatest possible use of the habitat remaining. This in turn requires that we have the fullest understanding of disturbance in order to find ways to minimize it while making even more intensive use of recreational and educational values of waterfowl.

Hunters and birdwatchers soon learn that the appearance of humans has become a major cause of fright in birds. The silhouette, face and eyes, and movement each contribute to the degree of alarm. As a human approaches a group of waterfowl on the ground they stop their feeding or loafing activity and assume a watchful stance. If they are located on or near open water they begin to swim away as the distance between them and the intruder is reduced. Geese on land will also walk away. As the critical distance of tolerance is reached they stop swimming or walking and take wing. The flight of a flock close to an intruder will often cause other flocks further away to take alarm and join them in flight. Sudden movement will send birds off in flight before the critical distance has been reached (Reid, 1967; Owens, 1977).

Birds and other animals are often more tolerant of approach if the human silhouette is not apparent. So humans on horseback or even on bicycles may cause less alarm provided that direct approaches are avoided. Similarly, mammals and birds will usually be less frightened of a car than of someone on foot. However, cars are most tolerated when, like railway trains, they adhere to a fixed route and regular speed. Waterfowl on Serpentine Fen ignore the traffic roaring past on the highways which form two of its borders, but they fly off in alarm if a car moves along one of the inner gravel roads which cross the marshes. Noisy, unusual or unpredictable movements of cross-country vehicles will frighten waterfowl away for long periods. Similarly motorboats cause considerable alarm among waterfowl. Routine, predictable movements of craft do not worry them; it is interesting to observe large flocks of Brant feeding each spring within a few metres of the berths at Drayton Harbour, Washington. But unfortunately the operators of small power boats that are driven for speed and excitement often find the temptation to steer into flocks of birds irresistible. Sometimes the unscrupulous or inexperienced hunter or one unfamiliar with the area is likely to use a boat to patrol the shore looking for concentrations of waterfowl. As David Hatler has pointed out, such a person

> . . . upon finding them in a hopelessly secure situation, will often make a futile attempt to approach them just in the hope that he might get a shot. He has only "this weekend" to hunt, and he doesn't have time for patience. Birds disturbed in this way fly . . .

in many cases to be met by the experienced local hunters who had anticipated their appearance.

But even if none of the hunters is successful, the disturbance reduces the attractiveness to waterfowl of the area, whether it be Roberts Bank or Clayoquot Sound, as described by Hatler. For, as he states:

> . . . the most reasonable measure of disturbance is involuntary movement of birds. When all of a group of birds rises in unison in response to an exteral stimulus such as the approach of a small boat, they have been disturbed. . . . The presence of . . . other areas (of waterfowl habitat) does not lessen the fact of disturbance, however; it is likely that these were at least temporarily less attractive, in some way, than the areas in which distrubance occurred, or the birds would have already been there (Hatler, 1973).

If, however, the alternative loafing or feeding places are also occupied by man or disturbed by boats then the effects upon waterfowl are more permanent. Repeated threatening or unpredictable movements of boats eventually cause most waterfowl to leave the area. On inland waters of limited size even sailboats and slow moving fishing boats cause a marked reduction in the bird population (Batten, 1977; DeJong, 1977; Hatler, 1973).

Observations at Serpentine Fen and in the Pitt Valley have shown that low-flying aircraft have the same effect as fast motorboats. The increase in air traffic over Boundary Bay resulting from the reopening of the Delta airport will probably have detrimental effects upon the numbers and variety of birds on the tidal flats. Recent studies of responses of wintering Brent Geese to human disturbance on the east coast of England are particularly relevant to the problem of human impacts upon Brant on the Lower Mainland coast (Ogilvie and Mathews, 1969; Harrison and Grant, 1976; Owens, 1977).

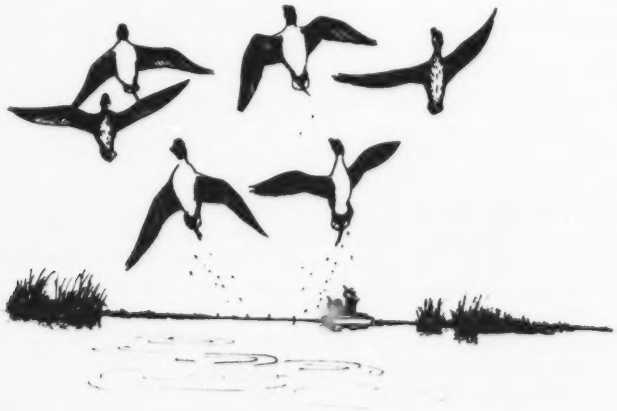
The minimum distance at which birds will tolerate humans varies with the species, with the habitat, and with the degree of disturbance prevalent in the area. Birds such as snipe or pheasants, which rely initially on camouflage and concealment for protection, will permit a very close approach. Diving ducks plunge underwater when first alarmed and later, if necessary, take flight. Other waterfowl rely mainly on space for protection, so they take wing at distances measured in hundreds of metres. In areas open to hunting they become increasingly wary as the open season progresses. When hunting ends they become more tolerant of human activities (Boudreau, 1968; Walters, Reed and Ward, 1973; Hatler, 1973).

Even when the hunting season is open, waterfowl are able to distinguish between hunters and other humans, such as farm workers, who are not a threat. Similarly they learn which places are safe and which are not. Ducks which fly unhesitatingly into parks and sanctu-

aries among people would not willingly come within 200 metres of a lone crouching figure on the marshes open to hunting. The behaviour of waterfowl in sanctuaries, like that of birds in parts of India where there are religious restraints on killing, indicates that fear of shooting is the strongest factor determining the behaviour of hunted species towards humans. Where that fear is reduced they become remarkably tolerant of people in their vicinity.

On the other hand the opposite is true in areas like the Lower Mainland where hunting pressure is high and areas of waterfowl habitat closed to hunting are comparatively small. The disturbance caused by any human activity on water-bird habitat, including bird-watching, hiking and beachcombing, is increased if the birds are hunted in the area. This is the situation which has made human disturbance such a major factor in determining the status of migratory birds in the Lower Mainland not only in the last century but also at the present time.

Apart from about 200 hectares within the Reifel Migratory Bird Sanctuary, all the undeveloped foreshores between Iona Island and Crescent Beach are traditionally open to hunting. So too are most of the agricultural lands of the Fraser's floodplain. Areas of upland closed to hunting are mostly the scene of too much human activity to serve the function of sanctuary areas. Some farms are closed to hunting by their owners but they are usually too small and isolated to have any major effect on the migratory habits of the waterfowl.



In the 1950s and 1960s an average of about 15,000 hunters were out on the Lower Mainland coast for an average of 14.4 days each season. Their total of 216,000 hunting days was an impressive illustration of the recreational value of wildlife, but it also represented a fearful degree of continuous harassment for the waterfowl of the delta.

In 1956 the provincial Game Commission Report stated:

> Waterfowl generally seem to be holding their own extremely well. This is quite remarkable when one considers the tremendous hunting pressure to which these birds are subjected. With such a large human population in the Lower Mainland and with more and more people turning to hunting as a form of recreation, all available waterfowl-shooting grounds can be considered to be put to maximum use (British Columbia, 1956).

Yet in spite of this optimistic tone the report went on to describe Brant as "scarce during the open season." Snow Geese though "abundant during the early part of the season," were "as usual . . . to be seen in offshore rafts," and they provided such poor morning and evening flights that "few were bagged by the sportsmen." Earlier reports over several years had made similar observations about the scarcity both of Snow Geese and Brant when hunting was open, though they were plentiful when it was over.

The disturbing effects of hunting on the geese were easier to observe because they were less numerous, more conspicuous, and more sedentary once they had arrived, than were the ducks which probably moved through the delta in successive waves of transients. Nevertheless, in 1951 the annual report contained the observation that ". . . despite the large numbers of ducks, for some reason the birds did not come in to feed until after dark along the coast."

Apparently no one in the Game Commission drew any conclusions from these annual observations in the 1950s, nor related them to the disappearance of the wintering Canada Geese from the Lower Mainland. This was in part because hunting pressure is measured mainly in terms of the number of birds killed on a continent-wide basis, rather than in terms of the actual impact of disturbance upon local waterfowl.

Paradoxically, although hunting takes a greater toll of waterfowl each year than any other cause of death, it is not a threat to the survival of any species of waterfowl in North America. Management by bag limits and seasons throughout Canada and the United States ensures the survival of sufficient birds of all species in each flyway to maintain a breeding population of about half the migratory population in the fall. The peak population of ducks and geese in North America totals about 80 million birds. Of these almost 20 million are shot and retrieved. A further 4 million are crippled and die. Lead poisoning kills between 1.6

and 2.4 million, mostly dabbling ducks. Disease, accidents and predation brings the annual death toll up to about 40 million. The survivors return to their nesting range and raise an average of 40 million young to fly south with them in the following fall (Bellrose, 1976).

The total number of waterfowl pausing on the delta during their southerly migration is unknown. An official "guesstimate" has placed it as high as 4 million, but this is more than half of the Pacific Flyway's average total of 7 million. To attain this figure the waterfowl population present on the Fraser would have to change over completely more than 26 times during the period of migration. Even the figure of 2 million seems high when we recall that the maximum number of dabbling ducks present at the peak of migration in November during the 1950s and 1960s seldom exceeded 200,000. The average number present during that month was 59,000. Yet the average seasonal bag of waterfowl totalled 200,000, including 188,000 ducks. Even when spread over the three months of the open season, these figures represent a high impact of disturbance upon the birds present on the delta (Taylor, 1970).

Since 1975 hunting pressure has decreased because, when the lower Fraser Valley became a "special licence area", the added costs of permits and insurance requirements caused the number of hunters to drop to about 5,400. Their estimated kill was only 48,600 waterfowl. This represents under 2.5% of 2 million transients or 0.7% of the 7 million waterfowl on the Pacific Flyway in the fall. But these figures alone give no indication of the effect of disturbance or harassment upon the survivors on habitat consisting, for the most part, of the comparatively narrow intertidal marshes readily accessible from the shore (Vermeer and Levings, 1977; Harris, 1977; Halladay and Harris, 1972).

Just as hunting pressure has been over simplified by being measured only in terms of birds shot, so too the waterfowl population of the Fraser delta is over simplified if it is regarded as a uniform body of migratory birds from which we can simply cull a harvest as it passes by. In fact the waterfowl present on the delta marshes represent at least three elements: a majority, which consists of transient birds which may stay for periods varying from a few hours to several weeks or even months; a smaller group, which remains throughout the winter on the delta but nests elsewhere; and a very small minority of year-round residents made up of both wild and feral birds which nest, moult and winter within the various coastal and inland wetlands of the Fraser. The severe disturbance inflicted on so high a proportion of the wetlands is obviously felt most by the wintering migrant and resident populations. Some of these birds have learned to find safe havens at Reifel Island, Burnaby Lake and Serpentine Fen. Elsewhere they sit offshore by day and feed at night.

Night feeding has long term adverse effects upon the health of waterfowl because it imposes limitations on their selection of foods. Items of low nutritive value are often consumed by ducks encountering them in the dark. Malnutrition is not uncommon among waterfowl and, though seldom the sole cause of death, it weakens them for the invasion of parasites and disease. Thus disturbance, even when it fails to drive the birds away, exerts unseen influences upon the welfare of waterfowl (Bellrose, 1976).

Factors contributing to disturbance include the number of hunters, the number of days open to hunting each week, the number of "hunter-days", and above all the proportion of the total waterfowl habitat open to hunting. There has been remarkably little effort to take these factors into consideration in the Lower Mainland where a large urban population concentrates an unusually heavy pressure of disturbance upon the wildlife of a small region. Yet experience elsewhere shows that with proper management hunting and other forms of recreation need not be seriously detrimental even to local populations in comparatively restricted areas. But "proper management" implies restraints on access, usually to about one third of the waterfowl habitat, to ensure that birds have adequate areas free from harassment in which to adhere to their essential daily cycles of feeding and loafing. The achievement of such management must surely become a major aim of conservation agencies on the lower Fraser River.

24. Thoughts About the Future

The instincts which led man from hunter to sportsman, can now be redirected into the more constructive role of preserver. The maintenance of the ecological balance is not only a more responsible use of man's power, but also a fundamental expression of the realization that man is part of his natural environment.

F. Vollmar
Secretary-General of the
World Wildlife Fund,
1970

I have the good fortune to live on a bluff above Semiahmoo Bay. To the south I look across a rock-strewn shore where diving birds congregate in large flocks throughout most of the year. In the dark of winter nights I hear the strange cry of the Oldsquaw and spring dawns are often greeted by the haunting call of a loon. To the southeast are the sands of White Rock and, beyond the international border, the oozy expanse of Drayton Harbour. To the northwest are the shallows and mud-flats of Boundary Bay and the delta of the Fraser. With each flow of tide and shift of wind the birds move along the shore. Change and movement, adaptation and evolution are the very basis of nature.

But inland, to the north, the last decade has brought change of rapid and drastic character where nature has been bulldozed and burned from the face of the land. With the trees and plants, the Ruffed

Grouse, Pileated Woodpecker, northern flying squirrel, shrew mole and tree toad are also gone; even the familiar red-legged frog and garter snake have become scarce. As I look out over the water I wonder whether the creatures of the shore are doomed to the same fate under the pressures of a burgeoning human population.

The last decade has brought some hope for their survival. There are now federal and provincial environment ministries with departments staffed by people who perceive the impacts of human developments upon natural systems. Farmlands and coastal waters have been recognized as having economic importance because they produce food. The aesthetic, recreational and educational values of natural areas and open space are also receiving recognition. Wildlife is no longer regarded merely as a resource to be harvested with rod, gun, net and trap. Conservation is now seen as a matter of protecting habitats and ecosystems. But the process, in the hands of government departments, is painfully slow.

Unfortunately there are still many people who cling to the attitudes and priorities of the past, and who refuse to admit the need for restraint in the use of habitat and of wildlife resources. They are unwilling to learn from the successful management of wildlife in other parts of the world, even those as close as the States to the south of us. Compared to the National Wildlife Refuges and State Wildlife Recreation Areas of Washington, Oregon and California, our contributions to the preservation and wise use of waterfowl habitats on the Fraser delta appear sadly inadequate (Leach, 1978; National Wildlife Refuge Study Task Force, 1978; Leach, 1979; Institute of Environmental Studies, 1980). Our refuges and sanctuaries are too small to fulfill the potential for the recovery and enhancement of wildlife that exists here. Furthermore, our wildlife management areas are neither staffed nor operated to meet the recreational or educational needs of the wider public. Recently, both provincial and federal wildlife management agencies have acknowledged that ". . . the efforts required to maintain and enhance waterfowl habitat . . . are beyond the capability of public agencies alone" (Environment Canada, 1980; see also Mair, 1977). But in spite of the contributions already made on the lower Fraser River by Ducks Unlimited, the B.C. Waterfowl Society, the Pitt Waterfowl Management Association and member clubs of the B.C. Wildlife Federation and Federation of B.C. Naturalists, there is still much to be done to achieve a true co-ordination of public and private organizations (Institute of Environmental Studies, 1980a). Nevertheless the recognition of this need is an important step forward. United, the public and private agencies concerned with wildlife conservation in the Lower Mainland will have a far better chance of obtaining adequate wetland habitats to compensate for the further loss and disturbance to be expected with the extension of the deep-sea harbour on south Roberts

Bank, the reactivation of Boundary Bay Airport and the myriad smaller developments that will take place on the shores and delta lands in the decades to come.

If the waterfowl, shorebirds and other wildlife of the lower Fraser River are to survive into the future, large areas of habitat must be protected against all further threat of development and managed to ensure that needs of wildlife for food and security are fully met. Furthermore, they must be of sufficient size that the recreational and educational needs and expectations of the public can also be provided within their bounds without undue disturbance of their wildlife.

We are fortunate that large areas of publicly owned wetlands still exist on Sturgeon and Roberts Banks and the deltaic islands of the Fraser, on Boundary, Mud and Semiahmoo Bays, on the greenbelt farms and Serpentine Fen between the lower reaches of the Nicomekl and Serpentine Rivers, and on the marshes and bogs of the Pitt River. But these are mainly loafing areas, so determined action is needed to acquire further lands now in private ownership in the Mud Bay lowlands, Burns Bog, Surrey Bend, on the upper Serpentine River, and in Delta. The cost of such acquisitions can be met in part by the resale of many of the small "greenbelts" purchased in farming areas with public funds in the past, and by the revenues generated by the major commercial developments on the lands and shores of the Fraser delta.

There must also be adequate staffing of the lower Fraser's wildlife habitats. This need has been clearly demonstrated in places like the Pitt Wildlife Management Area where the purchase of land by the Greenbelt Fund and the expenditure of thousands of dollars by Ducks Unlimited on dykes and water control structures were not immediately followed by the provision of staff to manage the public or to ensure the maintenance of the most productive water levels.

The management of the public in wildlife areas is not so much a matter of "policing" but rather one of information and education. The staff of such places provides the interface between citizens and their government service. Today most people know very little about the purpose, role, value and performance of the federal and provincial conservation agencies. Increased contact with the public would give these agencies a better chance of encouraging people to undertake conservation activities on their own property by digging ponds, constructing nesting islands and loafing bars of logs or rock, putting up nest boxes or introducing food and cover plants to unproductive waters. However small, such projects have a dual value; they benefit wildlife and they provide creative pleasure for the participants, a commodity all too rare in today's society of spectators and consumers.

At present most people are unaware of the inadequate protection and limited management given to the haunts of waterfowl along the lower Fraser River. Only a tiny minority, mostly hunters and naturalists, know and value the life and landscapes of the river. So there is a real danger that within a few years an indifferent public and its urban planners might contemptuously brush aside the shooting areas on the foreshores and marshes as a great anachronistic waste of land. Then the geese, swans and cranes will only be a small part of what is lost. But if we begin now to create a great imaginative system of sanctuaries, recreation areas and nature parks from Iona Island to Semiahmoo Bay, from Reifel Island to Pitt Lake, we shall build upon the very grandeur of nature itself; we shall contribute towards the continuance of waterfowl migrations which had their origins in the Great Ice Age, and help to maintain a landscape of richness and diversity unequalled on this coast. Above all, we shall protect something that so wins the hearts and minds of people along the Fraser River that it shall live as long as the cry of geese and the flight of ducks draws men's eyes to the sky.

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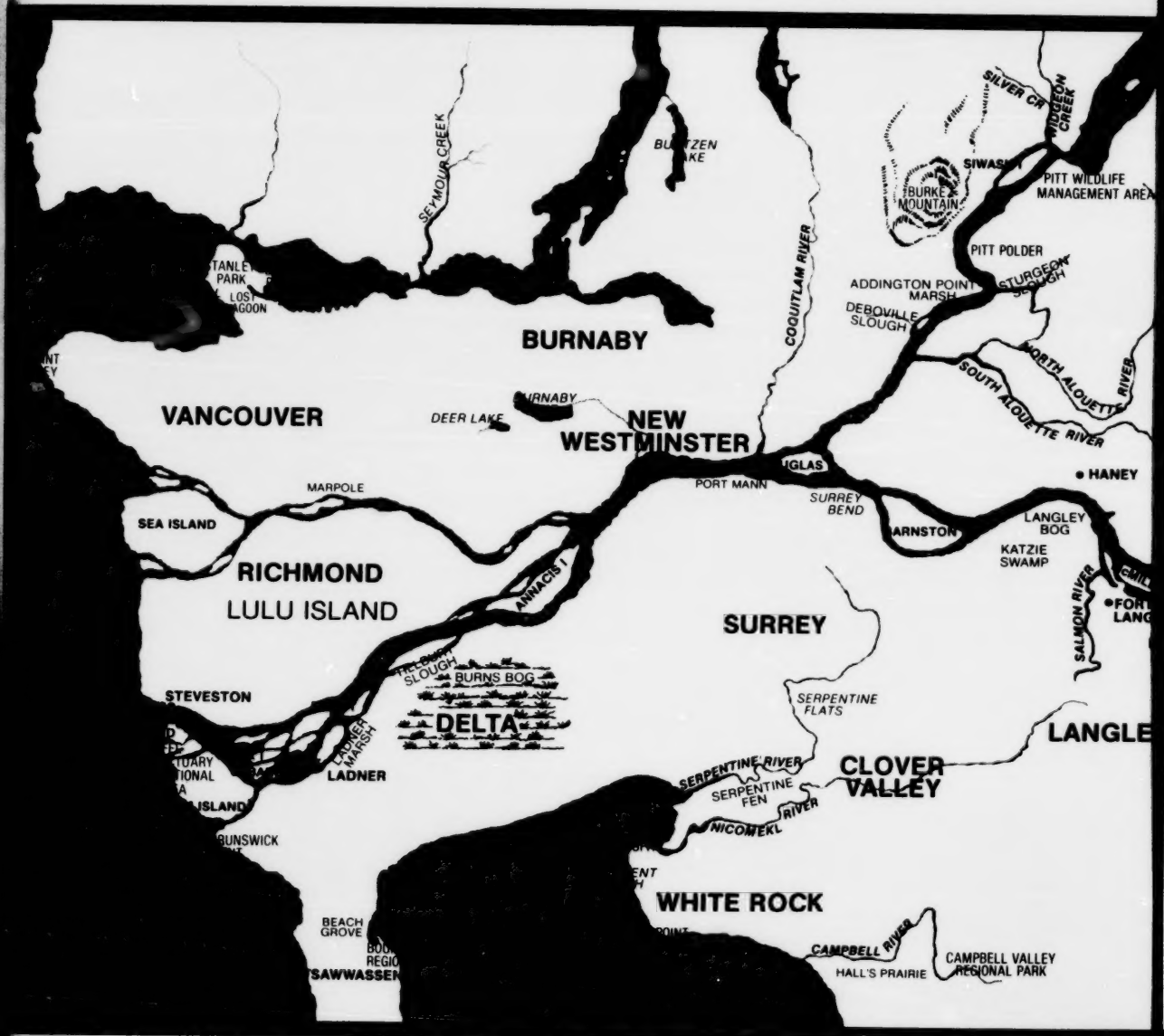
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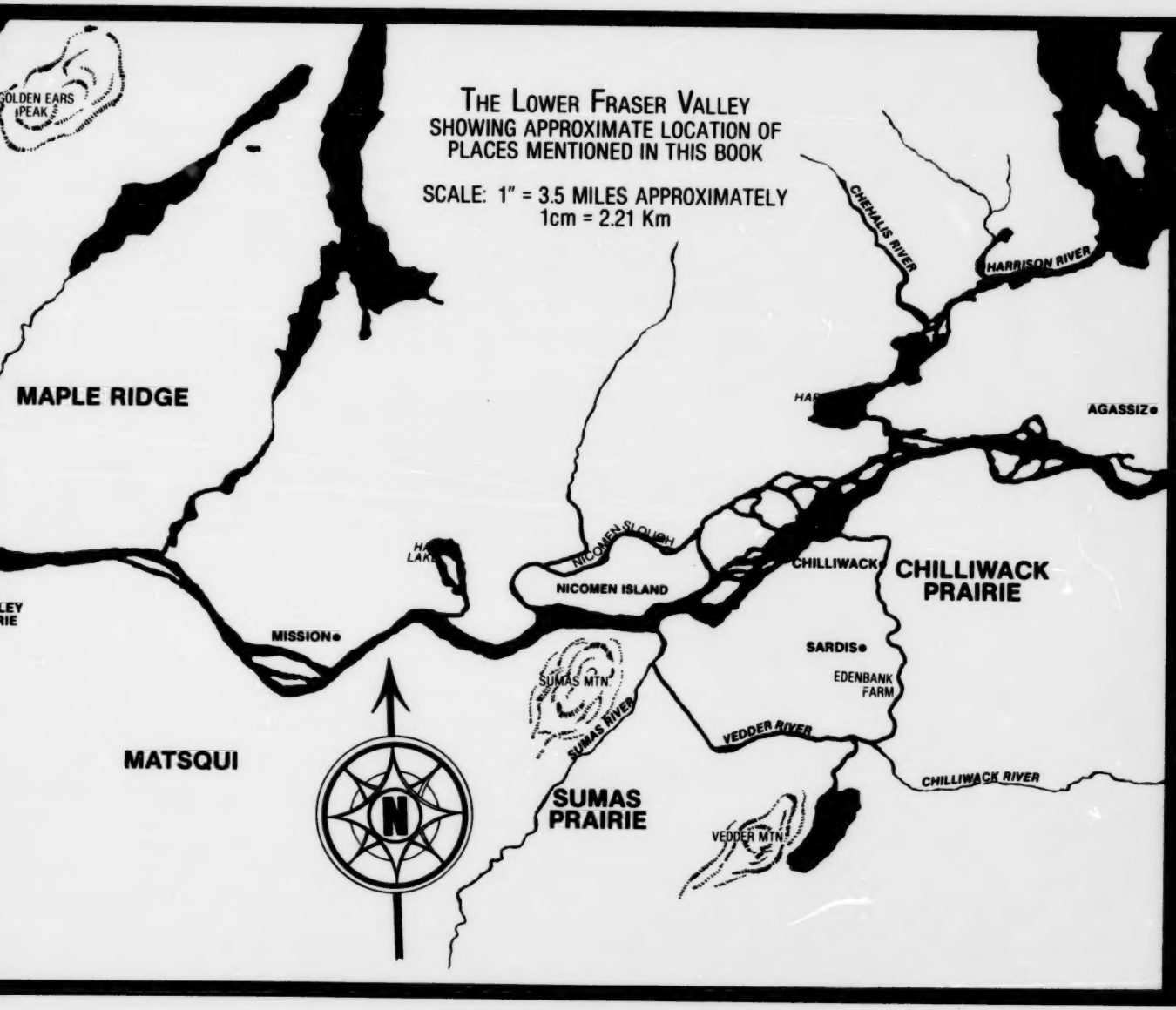
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1cm = 2.21 Km
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